

# Groundwater Sampling Results and Natural Attenuation Evaluation

## Oconomowoc Electroplating Site

### WA No. 236-RALR-05M8/Contract No. 68-W6-0025

TO: William Ryan/USEPA Region 5 WAM

FROM: Jeff Danko/CH2M HILL  
Cindi Cruciani/CH2M HILL  
Matt Boekenhauer/CH2M HILL

DATE: February 22, 2005

#### Tables

- 1 Compliance and Natural Attenuation Monitoring Program Locations
- 2 Field and Analytical Results – Groundwater Sampling – October 2004, July 2005, and October 2005
- 3 Groundwater Elevations
- 4 Screening for Anaerobic Biodegradation Processes and Interpretation of Screening Results

#### Figures

- 1 Site Map
- 2 Conceptual Depiction of Site Aquifer Units and Well Placement
- 3 Shallow Unconsolidated Zone Groundwater Elevations – October 2005
- 4 Deep Unconsolidated Zone Groundwater Elevations – October 2004
- 5 Deep Unconsolidated Zone Groundwater Elevations – July 2005
- 6 Deep Unconsolidated Zone Groundwater Elevations – October 2005
- 7 Bedrock Groundwater Elevations – October 2004
- 8 Bedrock Groundwater Elevations – July 2005
- 9 Bedrock Groundwater Elevations – October 2005
- 10 Groundwater TCE Concentrations ( $\mu\text{g}/\text{L}$ ) in Shallow Unconsolidated Wells--  
October 2004/July 2005/October 2005
- 11 Groundwater TCE Concentrations ( $\mu\text{g}/\text{L}$ ) in Deep Unconsolidated Wells –  
October 2004/July 2005/October 2005
- 12 Groundwater TCE Concentrations ( $\mu\text{g}/\text{L}$ ) in Bedrock Wells – July 2005
- 13 Groundwater cis-1,2 DCE Concentrations ( $\mu\text{g}/\text{L}$ ) in Shallow Unconsolidated  
Wells-- October 2004/July 2005/October 2005
- 14 Groundwater cis-1,2 DCE Concentrations ( $\mu\text{g}/\text{L}$ ) in Deep Unconsolidated  
Wells-- October 2004/July 2005/October 2005
- 15 Groundwater cis-1,2 DCE Concentrations ( $\mu\text{g}/\text{L}$ ) in Bedrock Wells – July 2005

#### Appendix A – Data Validation Memorandums

## Introduction

The Oconomowoc Electroplating Company (OEP) site is currently undergoing groundwater monitoring in accordance with the *Groundwater Management Plan (GMP)*, dated March 2005, prepared by CH2M HILL for the site. The 10-acre study area comprises the former 4-acre OEP site (bounded by Elm, Oak, and Eva Streets, and Town of Ashippun buildings) located at 2572 Oak Street in Ashippun, Wisconsin, and 6 acres of a wet, low-lying area located adjacent to the southwest portion of the former site (Figure 1). This low-lying area is referred to in historical and recent project plans as a wetland area.

Figure 1 includes the positions of wells that are monitored at the OEP site. Monitoring has been completed at the site to meet two separate objectives:

1. Compliance Monitoring – Semiannual sampling completed to evaluate impacts to potential receptors by collecting samples from residential wells, monitoring wells, and surface water samples located downgradient from the facility. State and federal groundwater and surface water standards are used to evaluate compliance monitoring samples. Compliance monitoring includes analysis of volatile organic compounds (VOCs) using the U.S. Environmental Protection Agency (USEPA's) method SW 846 8260. An offsite laboratory was subcontracted by CH2M HILL to analyze compliance samples. Analytical results were then validated by USEPA.
2. Natural Attenuation Monitoring – Quarterly sampling (for 2 years) to evaluate the use of monitored natural attenuation (MNA) as a stand-alone remedy by collecting groundwater samples throughout the site and surface water samples within Davy Creek. NA analytes include nitrate, dissolved manganese, total and dissolved iron, sulfate, sulfide, methane, ethane, ethene, chloride, alkalinity, VOCs, and soluble organic carbon. Field parameters collected for NAM include field measurement of water level, temperature, pH, specific conductance, dissolved oxygen, and oxidation-reduction potential (ORP). An offsite laboratory was subcontracted by CH2M HILL to analyze the samples using methods described in the project Quality Assurance Project Plan (QAPP). A CH2M HILL chemist reviewed the NAM laboratory results for conformance with project-specific analytical requirements.

Table 1 provides the list of those locations designated for samples for each program. Note that some of the locations were sampled for both types of monitoring.

Figure 2 is a conceptual depiction of the site's aquifer units and shows the relative depth where monitoring wells are placed within the units. Two units are monitored at this site, including the unconsolidated material above bedrock and the shallow-bedrock material. The unconsolidated material beneath the OEP site consists of between 28 and 55 feet of silty sand and clay, with some sporadic presence of silt and/or clay fill. Monitored wells in this material include both the more "shallow" or water table zone wells and the "deep" wells that monitor the lower portion of the unconsolidated zone. Wells are designated as either "S" or "D" in this zone, respectively.

The shallow-bedrock material consists of the Maquoketa shale, but has discontinuous dolomite beds which can yield water. Monitoring wells generally are designated as "B" in

this zone, except for MW-1D, MW-2D, MW-3D, and MW-4D. These older monitoring wells were installed in 1988 and are also screened to sample the bedrock material.

Details on historical site activities, previous remedial actions, and previous groundwater analytical results (pre-2004) are fully described in the GMP.

Groundwater monitoring results for both regulatory compliance and NAM are summarized in Table 2, including a side-by-side comparison for all three rounds of data collected to date (October 2004, July 2005, and October 2005). Measured groundwater depths and resultant groundwater elevations are included in Table 3.

## Sampling Approach

Sampling and analysis was completed in accordance with the *Sampling and Analysis Plan* (SAP) dated October 2004 (CH2M HILL). Water levels were measured and recorded for all accessible groundwater monitoring wells, drive point piezometers, and staff gauges during the first day of the sampling event. The measured water levels and well depths (described in FOP No. 2—Groundwater Level Measurements) were used to calculate a purge volume and to assess the thickness of solids deposited at the bottom of the well screen. Resultant groundwater elevations are shown in Table 3. Wells were purged and sampled as described in FOP No. 1—Low-Flow Groundwater Sampling Procedures. Groundwater field parameters were monitored with a multimeter and flow-through cells during well purging. The wells were purged continuously until monitored field parameters stabilized within the limits specified in FOP No. 1—Low-Flow Groundwater Sampling. Procedures for field filtering all groundwater samples were followed per FOP No. 5—Field Filtering Samples. Non-dedicated sampling equipment was decontaminated between locations using FOP No. 6—Field Sampling Equipment Decontamination. Samples were collected immediately following the stabilization of groundwater field parameters. The samples were processed, packaged, and shipped on the day of collection.

Private well locations were sampled as part of July 2005 compliance monitoring in accordance with FOP No. 10—Private Residential Well Groundwater Sampling Procedures included in the SAP. Private well taps were opened for 10 to 15 minutes prior to sampling. Each sample was collected from a tap before any water softeners or other treatment. Note that PW-06 could not be located and was, therefore, not sampled.

Collection of three surface water samples for regulatory compliance and NAM parameters was planned for locations coincident with three staff gages. The unusually dry conditions in Southeastern Wisconsin in October of 2005, however, resulted in the absence of ample water at these locations from which to collect samples for analytical testing.

## Data Management

USEPA software Forms II Lite 5.1 was used in the field to enter field sample data and create the chain-of-custody (COC) forms. The USEPA copies of the COCs were used to enter sample information into the sample tracking spreadsheet. Upon receipt of the samples, the laboratories transmitted an electronic sample receipt, which was then compared to the COC and entered into the sample tracking spreadsheet. Within 21 days of receipt of the last

sample, the laboratory provided CH2M HILL with an electronic data deliverable (EDD), one hard-copy data package and a .pdf file of the data package. After receipt and completeness check, the hard-copy data package was sent to USEPA for validation of the compliance sample data. After the data validation was completed by USEPA for compliance data and by CH2M HILL for NAM data, the validation summaries were reviewed by the CH2M HILL project chemist and the qualifiers were entered into the EQUS database.

## Data Validation

USEPA performed data validation on the compliance sample analytical data. The CH2M HILL project chemist performed data validation on the NAM sample analytical data in a manner consistent with *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (October 1999) and *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (July 2002). Compliance and NAM data were both deemed valid for use, with the exceptions noted in Data Validation Memorandums produced for each sampling event (Appendix A).

## Data Evaluation

### Groundwater Flow Directions

Groundwater elevation maps were compiled for each group of wells for shallow and deep unconsolidated zones and for the bedrock zones. Shallow groundwater flow directions in the unconsolidated zone for October 2004 and for July and October 2005 indicate that flow at the water table appears to be mostly toward the south, with southwestern and southeastern components. Figure 3 is the October 2005 groundwater elevation map, which is representative of the groundwater flow direction noted for all three dates. MW-9S at the southeast is consistently a low point in the shallow wells. This flow direction is toward the location of Davy Creek, although water levels in the creek were not present and, therefore, not measured. The completion of the shallow and deep well installations at the MW-107 nest (Figure 1) will add definition to the groundwater flow direction in the vicinity of the creek. MW-107S has been installed but not surveyed. MW-107D installation has not yet been completed but will be installed in spring 2006 when ground conditions in this wet area allow. Both wells will be surveyed after MW-107D installation. All three groundwater elevation maps (October 2004, July 2005, and October 2005) for the shallow zone are consistent with that shown in RMT, Inc.'s (RMT's) 2004 report for July 2003 (Figure 3-3: RMT, 2004).

Groundwater flow directions in the deep unconsolidated zone for October 2004 and July 2005 (Figures 4 and 5) indicate that flow direction is toward the south through the center of the site; toward the southeast, east of center; and toward the west, west of center. October 2005 groundwater elevation contours indicate a reverse of flow direction toward the north (Figure 6). MW-5D is the relative low elevation in the deep wells during each monitoring event. The July 2003 groundwater flow direction for these wells is toward the south/southwest (Figure 3-4: RMT, 2004).

Groundwater flow directions in bedrock monitoring wells are shown for October 2004, July 2005, and October 2005 in Figures 7 through 9. A groundwater divide, consisting of a set of wells with higher elevations, is present through the center of the site in October 2004 and July 2005 (MW-15B, MW-2D, MW-1D) with flow toward the north and south from this divide. In October 2005 (Figure 9), the higher elevations are limited to the MW-2D and MW-1D locations, with apparent flow direction to the north, west, and south from this divide. These figures do not match with the groundwater elevation contours shown for July 2003 in the RMT report (Figure 3-5: RMT, 2004). Several data points on the figure were not used by RMT in creating the contours as indicated, however. A reason was not given on the figures nor in the text as to why certain points were not used, just that they were "anomalous). When contours are re-drawn using all the data points in the July 2003 figure, flow directions are consistent with those indicated from 2004 and 2005 data.

## Compliance Monitoring Results

### Private Well Sample Results

Validated analytical results for October 2004, July 2005, and October 2005 are shown side by side in Table 2. Laboratory analytical data sheets have been placed in the project record. VOCs were detected at relatively low concentrations in some of the private wells in July 2005. USEPA was notified of the detections and provided with draft notification letters on December 2, 2005.

VOC compounds detected at least once in private wells during 2005 compliance sampling include 1,1-dichloroethane (1,1-DCA); 1,2-DCA; carbon disulfide; chloroform; chloromethane; cis-1,2-dichloroethene (cis-1,2-DCE); isopropylbenzene; m,p-xylene; methyl tert-butyl ether; o-xylenetrans-1,2-DCE; trichloroethene (TCE); and vinyl chloride (Table 2). Chloroform and chloromethane are often detected as by-products of drinking water well chlorination—some private well owners chlorinate wells. All 2005 VOC detections in groundwater collected from the private wells were below *Wisconsin Administrative Code (WAC) Chapter NR 140 Enforcement Standard (ES)* concentrations for respective compounds. However, the groundwater collected from two of the private wells had estimated concentrations of vinyl chloride above the *WAC Chapter NR 140 Preventive Action Limit (PAL)* concentration of 0.02 µg/L. These wells and their respective estimated vinyl chloride concentrations are:

PW-07 (2602 Elm Street) 0.042 µg /L (estimated)

PW-09 (2606 Elm Street) 0.05 µg /L (estimated)

In general, the constituents detected in groundwater collected from the private wells during July 2005 sampling were at concentrations slightly below the detection limits used by RMT/Wisconsin Department of Natural Resources in 2003. Note that these wells are positioned in an apparently downgradient direction from the OEP site during at least some times of the year, as indicated by bedrock groundwater elevation maps (Figures 7 through 9).

### Monitoring Well Results

PAL values are generally 10 to 50 percent of the ES values for their respective individual compounds. ES values frequently correspond to USEPA's maximum concentration limits

(MCLs). Table 2 provides data for all three recent groundwater sampling rounds (October 2004, July 2005, and October 2005), along with an indication as to whether PAL or ES concentrations are exceeded.

During the three sampling events included in this evaluation, the following compounds were detected at or above their respective ES in at least one monitoring well location: chloride; iron; manganese; sulfate; bromodichloromethane; cis-1,2-DCE; 1,1 DCE; methylene chloride; 1,1,1-trichloroethane (1,1,1-TCA); 1,1,2-TCA; TCE; and vinyl chloride (VC) (Table 2). In addition to these compounds, nitrate; 1,1-DCA; 1,2-DCA; benzene, chloromethane, and tetrachloroethene were detected above their respective PAL.

PAL and ES exceedances of organic compounds were generally observed in the near source well nest (MW-103) or at well nests (shallow and deep locations) near downgradient Davy Creek south-southwest of the site (MW-12, MW-13, MW-15, MW-16, and MW-105). The exception includes the manganese exceedances observed at MW-14D (upgradient well) and the total iron exceedances at MW-001S. There were no bedrock monitoring wells with ES exceedances. The only bedrock monitoring well with a PAL exceedance was MW-105B with a VC concentration of 0.059  $\mu\text{g} / \text{L}$ , versus the PAL of 0.02  $\mu\text{g} / \text{L}$ . This well is located immediately downgradient of the onsite source area (Figures 7 through 9).

## Natural Attenuation Results

### Background

As discussed in more detail in the GMP, many organic compounds can be attenuated naturally to nonregulated end products, and monitoring and documentation of these processes is known as natural attenuation monitoring (NAM). In anaerobic-reducing environments, the main degradation mechanism for effective chlorinated volatile organic compound (CVOC) attenuation is reductive dechlorination, which involves the sequential replacement of chlorine atoms on the alkene molecule by hydrogen atoms. For TCE, a site constituent, the sequential dechlorination proceeds to 1,2-DCE, preferentially the cis-isomer, and to VC, and finally to ethene. For 1,1,1-TCA, also a site constituent, the degradation products include 1,1-DCE, VC, and ethene; or 1,1-DCA, chloroethane, and ethanol – with the final product in both pathways being carbon dioxide.

The Office of Solid Waste and Emergency Response (OSWER) Directive 9200.4-17 (1999) identifies three lines of evidence that can be used to demonstrate the occurrence of the NA of CVOC compounds, consisting of the following:

- Documented loss of primary contaminants at the field scale
- Documented presence and distribution of geochemical and biochemical indicators of NA
- Direct microbiological evidence

For this project, NA is being evaluated using the first two lines of evidence.

### Distribution of Organic Compounds

In general, the distribution of parent products, TCE and 1,1,1-TCA, in the shallow aquifer extends from the southern portion of the site generally south of Elm Street toward the wetland area, corresponding with the groundwater flow direction in the shallow unconsolidated zone. Figures 10 through 12 present the TCE concentrations for October

2004, July 2005, and October 2005, respectively. TCE was detected at the highest concentrations in the shallow zones from samples collected at points immediately beneath or directly south of the OEP building (MW-103S, MW-12S, and MW-105S), consistent with that seen in pre-2004 samples (Figure 10). TCE was detected at the highest concentrations in the deep unconsolidated zone at those same locations (Figure 11--MW-103D, MW-12D, and MW-105D). 2005 TCE concentrations are all at one order of magnitude higher in MW-103D versus MW-103S. The MW-105 well nest, situated due south of MW-103, has shown a rough order of magnitude decrease in concentration between 2003 and 2005 sampling events for both shallow and deep unconsolidated zones. TCE detections in bedrock wells and from private wells are at such low, estimated concentrations that it is difficult to determine the highest concentration (Figure 12). Additional sample results (first quarter 2006) will confirm or refute July 2005 TCE detections in bedrock wells.

The distribution of 1,1,1-TCA concentrations are similar to the TCE distribution, except with a more limited extent and lower concentrations. The well nests with the highest concentrations of 1,1,1-TCA are MW-12 and MW-103. MW-103 has higher concentrations in its deep well; MW-12 has higher concentrations in its shallow well. There are no detections of 1,1,1-TCA in any of the bedrock monitoring wells or private wells sampled during 2005.

Concentrations of degradation products of TCE and 1,1,1-TCA detected during the 2004 and 2005 sampling events were similar to those measured during the April 2003 sampling event, and include cis-1,2-DCE, VC, 1,1-DCA, 1,1-DCE, and chloroethane. The highest concentrations of degradation products were observed near the apparent source area (MW-103 well nest). In general, degradation products were detected further toward Davy Creek than parent products, including those sampled wells closest to Davy Creek (MW-16S). Figures 13 through 15 include cis-1,2 DCE concentrations for shallow and deep unconsolidated zones and for the bedrock zone, respectively.

In spite of the groundwater treatment system shutdown in July 2004, the October 2004, July 2005, and October 2005 data show similar concentrations and distribution of TCE, TCA, and associated degradation products when compared to a previous sampling round in April 2003, when the system was in operation. This suggests that the CVOC plume is currently stable. The exception to this situation is indicated at the MW-105 well nest, due south of the OEP building, which shows a rough order of magnitude decrease in TCE concentration between 2003 and 2005.

## Natural Attenuation Data

Based upon groundwater monitoring data for the last three rounds in the shallow and deep unconsolidated zone, parent products in groundwater (TCE and 1,1,1-TCA) are being degraded by anaerobic reductive dehalogenation and other NA processes to transformation products (1,2-DCE, VC, 1,1-DCA, 1,1-DCE, chloroethane, and methane). Additionally, final and nontoxic degradation byproducts, ethene and ethane, were also detected at the site. The detection of ethene and ethane indicates that microorganisms currently present in the subsurface and downgradient of the site have the capacity to degrade parent products through each step of the dechlorination degradation process. Ethane can also be produced by plants during spring and summer vegetative growth phases, so any significant ethene or ethane data noted during fall or winter months suggest that the ethene/ethane is likely the result of CVOC reductive dechlorination and not derived from natural vegetation that may

be present. Based on the data collected to date, the presence of ethene/ethane in the groundwater provides evidence that CVOCs are being dechlorinated to environmentally-acceptable end products.

Dissolved oxygen (DO) and ORP were measured during well purging to assess the redox conditions in the groundwater. DO results are extremely variable from event to event and between monitored zones, and do not support any obvious trends; DO can be a very difficult parameter on which to obtain accurate field readings. Results of field measurements of ORP support the occurrence of reductive dehalogenation in the area of CVOC detection by the measurement range of between +50 millivolts and lower (including negative readings). The area of ORP values that is "optimal" for reductive dehalogenation gets smaller, however, in the shallow zone between October 2004 and October 2005. The main downgradient location, MW-16, is the only shallow well location that has optimal ORP range in October 2005. This apparent change in ORP may be a result of the lower water levels between the two dates (i.e., 844.68 feet above mean sea level in April 2003 versus 842.65 in October 2005; a decrease of 2.03 feet); lower water levels will allow more oxygenated conditions in the aquifer because of the presence of an increased amount of unsaturated material.

ORP in the deep zone remains optimal for the MW-13D, MW-12D, and MW-105D locations in October 2005; a somewhat reduced area from October 2004 and July 2005. These data suggest that anaerobic conditions exist within the proximity of the downgradient wetland area located near well nests MW-12, MW-13, and MW-16. In areas outside these optimal zones, i.e., beneath the site and west/north of the site in the shallow and deep zones, CVOC NA will likely be dominated by advective and dilution processes only. All bedrock readings of ORP in July 2005 are at optimal readings; i.e., they are all less than 50 millivolts.

In general, alkalinity, dissolved iron, and methane were detected at the highest concentrations in the shallow zone at MW-16S, directly downgradient of the site and near the wetland area. Shallow locations MW-12S, MW-103S, and MW-105S also have elevated readings for these constituents. The deep zone wells with the most elevated readings for these constituents are the MW-13D, MW-12D, MW-15D, and MW-105D locations. Similarly, total organic carbon and chloride were also observed to have the highest concentrations at shallow well location MW-16S and at MW-13S, MW-12S, MW-105S, and MW-103S locations, along with MW-15D in the deep zone. Increased concentrations of alkalinity, iron, methane, and chloride in the source and southern areas compared to upgradient/background locations provide evidence of biodegradation (Wiedemeier et al., 1998).

Chloride concentrations are three to four times higher than background in the area of highest CVOC detections. During each step of the reductive dehalogenation process, chloride is released as a by-product. The chloride observations also support the second line of evidence of NA (USEPA 1999).

Sulfate concentrations observed for the study area (generally observed at or above 60 mg/L), especially at locations located within the wetland area, are at concentrations that are not the most favorable for biodegradation (the favorable range is less than 20 mg/L).

Methane is produced by the metabolism of a wide range of organic substrates by methanogenic bacteria. This group of bacteria is known to play a role in CVOC attenuation.



Ethene and methane have been detected in samples collected from well nests MW-12, MW-16, MW-105, and MW-103D, indicating that methanogenic conditions exist at portions of the study area. Data collected from other areas of the study area suggest NA is occurring, but at a much reduced rate when compared to the wetland area. A decreasing trend in methane from 2004 to 2005 was noted for concentrations at these well locations in the shallow zone, possibly indicative of the drought-like conditions in 2005.

Analytical results for sampling performed in October 2004, July 2005, and October 2005 provide support for the occurrence of NA of CVOCs at and downgradient of the site, including:

- Detections of ethene and ethane, the end biodegradation products of TCE and 1,1,1-TCA.
- The detection of TCE and 1,1,1-TCA degradation products documents the loss of contaminants achieving the first line of evidence of NA (USEPA, 1999).
- Detection of dissolved iron, alkalinity, and methane above background concentrations in the area of CVOC detections indicates the presence of reducing conditions needed for biodegradation to occur. Nitrate was generally not detected or was below 1 mg/L, further supporting conditions appropriate for biodegradation. These geochemical and biochemical conditions are indicators of NA and support the second line of evidence of NA (USEPA, 1999).
- The observance of chloride concentrations three to four times higher than background in the area of highest CVOC detections.
- Using the methods presented by Wiedemeier and others (Wiedemeier et al., 1998), data were compared to the preferred concentrations of NA indicator parameters for an overall screening of study area conditions. Based on data collected in the NA evaluation, "adequate evidence" supporting anaerobic biodegradation of chlorinated organics for the unconsolidated aquifer is present (Table 4).

## Potential Groundwater Receptors

Potential human and ecological receptors for the OEP site's groundwater include Davy Creek and its associated wetland area, private water-supply wells, and residential structures. Davy Creek and its associated wetland area may be impacted by the discharge of unconsolidated zone groundwater migrating from the site. Based on 2004 and 2005 groundwater data, the downgradient extent of CVOC degradation products is not known, but CVOCs were detected at wells located closest to the creek (MW-16S and MW-13D). These wells were installed in areas that were accessible in the wetland area nearest the creek. It is unknown whether all of the groundwater in the unconsolidated unit (shallow and/or deep) discharges to Davy Creek or whether part of it flows beneath the creek. When the well nest of shallow and deep well screens are installed at the MW-107 location (south of Davy Creek), compliance and MNA will be completed. MW-107 wells have not been completed yet because the access path to the proposed location has been too wet and soft to support vehicle traffic. Groundwater quality and elevation data will be available during future sampling events from this location.

## Conclusions

Source reduction activities have been previously performed at the site and include the removal of the former lagoon sediment and sludge, contaminated soil, and contaminated sediment in the wetlands around Davy Creek and the operation of a groundwater extraction system.

October 2004, July 2005, and October 2005 data show similar concentrations as those measured in the previous sampling round of April 2003, when the groundwater extraction system was in operation. This suggests the CVOC plume is stable.

Groundwater chemistry data indicate evidence supporting NA of CVOCs near the shallow downgradient portions of the CVOC plume. Monitoring data suggest that, to date, significant NA occurs at or near the wetland area located on the south side of the site. Specifically, the data collected from well nests MW-12, MW-13, and MW-16 show anaerobic conditions exist that are contributing to NA of CVOCs.

The migration of CVOCs appears to be primarily occurring in the unconsolidated zone groundwater onsite and south of the site. NA in the wetland area, south of the site, should minimize further migration and appears to be meeting remedial goals for the site.

Unconfirmed detections of low concentrations of chlorinated compounds are present in July 2005 samples from private water supply wells.

## Recommendations

Monitoring data collected over time can be used to verify that NA is sufficient to control CVOC migration such that MNA may be an appropriate stand-alone remedy.

CH2M HILL recommends the continuation of groundwater monitoring as specified in the SAP dated October 2004. This SAP included a QAPP, Field Sampling Plan, and a Data Management Plan. Quarterly groundwater sampling events should be continued for another 2 years to collect MNA data to properly evaluate seasonal trends in the biogeochemistry and NA. In addition to MNA, CH2M HILL recommends the program be enhanced in 2006 to monitor potential receptors and detect plume expansion through:

- The completion of a nested monitoring well pair on the south side of Davy Creek (at the approximate location shown for MW-107S/D in Figure 1). This well nest will evaluate the flow between Davy Creek and the shallow and deep unconsolidated groundwater, and serve as sentinel wells to evaluate plume expansion.
- The addition of surface water monitoring in Davy Creek and the wetland area at three locations: upstream in Davy Creek, downgradient from the site in Davy Creek, and downgradient from the site in wetland area. (Surface water monitoring could not be completed in 2005 because of extremely dry conditions in southern Wisconsin; i.e., there was not water present in the Creek in sufficient quantity to obtain a surface water sample).
- Re-sampling of private wells early in first quarter 2006 in the vicinity of OEP to confirm the presence of low concentrations of chlorinated compounds detected during July 2005

sampling. Once results from these wells are validated and evaluated, an assessment should be made as to further sampling and or recommendations.

If CVOCs are detected in the sentinel well nest (MW-107), or if plume expansion is documented for several consecutive quarters of monitoring, the implementation of a contingency plan is recommended. The contingency approach may consist of modifications to the monitoring program or remediation approach for the site. For example, if trends in groundwater data suggest an expanding plume, additional wells may be monitored or the frequency of monitoring may be increased.

In the event that CVOCs are confirmed in private water-supply wells at concentrations above the MCLs, additional remedial activities should be considered. These may consist of point of service treatment or enhancement of NA through the addition of carbon substrates to the groundwater, respectively. A detailed design would be prepared, if deemed necessary, for USEPA review and approval.

## References

- CH2M HILL. 2004. *Sampling and Analysis Plan Oconomowoc Electroplating, Oconomowoc, Wisconsin.*
- RMT Inc. 2004. *Hydrogeologic Investigation and Groundwater Extraction System Evaluation.*
- USEPA. 1999. *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites.* OSWER Directive 9200.4-17P.
- Wiedemeier, T. H., et al. 1998. *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater.* EPA/600/R-98/128.

## Tables

---

**TABLE 1**

Compliance and Natural Attenuation Monitoring Program Locations  
 Oconomowoc Electroplating, Oconomowoc, Wisconsin

Well Name/Location	Monitoring Zone	Water Level Measurement	Compliance Sampling (1)	Natural Attenuation Sampling (2)	Comments
<u>Water Supply Wells</u>					
PW-01	GW-Upper bedrock		X		2551 Oak Street, Town of Ashippun
PW-02	GW-Upper bedrock		X		2580 Oak Street, Krier
PW-03	GW-Upper bedrock		X		2601 Oak Street, McMullen
PW-04	GW-Upper bedrock		X		2605 Oak Street, Otto
PW-05	GW-Upper bedrock		X		2611 Oak Street, Peirick
PW-06	GW-Upper bedrock		X		547 Eva Street, Krier (rental property owner)--As of July 2005 well could not be located
PW-07	GW-Upper bedrock		X		2602 Elm Street, Krier
PW-08	GW-Upper bedrock		X		2603 Elm Street, Kehl
PW-09	GW-Upper bedrock		X		2606 Elm Street, Otto
PW-10	GW-Upper bedrock		X		2607 Elm Street, Burrow
PW-11	GW-Upper bedrock		X		2612 Elm Street, Fortlage
<b>SUBTOTAL</b>			11		
<u>Monitoring Wells</u>					
MW-1S	GW-Shallow unconsolidated	X		X	Upgradient
MW-1D	GW-Upper bedrock	X			
MW-2D	GW-Upper bedrock	X			
MW-3S	GW-Shallow unconsolidated	X			
MW-3D	GW-Upper bedrock	X			
MW-4S	GW-Shallow unconsolidated	X			
MW-4D	GW-Upper bedrock	X	X		Downgradient
MW-5	GW-Shallow unconsolidated	X			
MW-5D	GW-Deep unconsolidated	X	X		Downgradient
MW-9S	GW-Shallow unconsolidated	X			
MW-12S	GW-Shallow unconsolidated	X	X	X	Downgradient
MW-12D	GW-Deep unconsolidated	X	X	X	Downgradient
MW-12B	GW-Upper bedrock	X	X		Downgradient
MW-13S	GW-Shallow unconsolidated	X	X		Downgradient
MW-13D	GW-Deep unconsolidated	X	X	X	Downgradient
MW-14D	GW-Deep unconsolidated	X		X	Upgradient
MW-15S	GW-Shallow unconsolidated	X	X	X	Downgradient
MW-15D	GW-Deep unconsolidated	X	X	X	Downgradient
MW-15B	GW-Upper bedrock	X	X		Downgradient
MW-16S	GW-Shallow unconsolidated	X	X	X	Downgradient
MW-101S	GW-Shallow unconsolidated	X			
MW-101B	GW-Upper bedrock	X	X		Downgradient - sentinel well
MW-102S	GW-Shallow unconsolidated	X			

**TABLE 1**

Compliance and Natural Attenuation Monitoring Program Locations  
 Oconomowoc Electroplating, Oconomowoc, Wisconsin

Well Name/Location	Monitoring Zone	Water Level Measurement	Compliance Sampling (1)	Natural Attenuation Sampling (2)	Comments
<u>Monitoring Wells Continued</u>					
MW-102D	GW-Deep unconsolidated	X	X		Downgradient - sentinel well
MW-103S	GW-Shallow unconsolidated	X		X	Near source area
MW-103D	GW-Deep unconsolidated	X		X	Near source area
MW-104S	GW-Shallow unconsolidated	X			
MW-104D	GW-Deep unconsolidated	X			
MW-105S	GW-Shallow unconsolidated	X	X	X	Downgradient
MW-105D	GW-Deep unconsolidated	X	X	X	Downgradient
MW-105B	GW-Upper bedrock	X	X		Downgradient
MW-106S	GW-Shallow unconsolidated	X	X		Downgradient - sentinel well
MW-106D	GW-Deep unconsolidated	X	X		Downgradient - sentinel well
MW-107S (4)	GW-Shallow unconsolidated	X	X	X	Downgradient - sentinel well
MW-107D (4)	GW-Deep unconsolidated	X	X	X	Downgradient - sentinel well
OW-6	GW-Upper bedrock	X			
<b>SUBTOTAL</b>		<b>36</b>	<b>20</b>	<b>14</b>	
<u>Drive Point Piezometers</u>					
P-1	SW	X			
P-2	SW	X			
P-3	SW	X			
<b>SUBTOTAL</b>		<b>3</b>			
<u>Staff Gauges</u>					
SG-1	SW	X	X	X	
SG-2	SW	X	X	X	
SG-3	SW	X	X	X	
<b>SUBTOTAL</b>		<b>3</b>	<b>3</b>	<b>3</b>	
<b>TOTAL</b>		<b>42</b>	<b>34</b>	<b>17</b>	

(1) Compliance sampling includes the analysis of VOCs. Water levels would be taken at all accessible monitoring wells, drive point piezometers, and staff gauges. Semi-annual sampling will be performed.

(2) Natural Attenuation sampling includes the analysis of VOCs and natural attenuation parameters (nitrate, diss. Managnese, total and diss. Iron, sulfate, sulfide, methane, ethene, ethane, chloride, alkalinity and soluble organic carbon) and the measurement of field parameters (temperature, pH, specific conductivity, dissolved oxygen, and oxidation reduction potential). Water levels would be taken at all accessible monitoring wells, drive point piezometers, and staff gauges. Quarterly sampling will be performed to evaluate seasonal trends in natural attenuation parameters for a two year period.

(3) Surface water monitoring will be performed for the same analysis and frequency as NA groundwater sampling. In addition, Orthophosphate and ammonia will be performed on surface water samples.

(4) Proposed groundwater monitoring well nest on the south side of Davy Creek.

GW-Groundwater

SW-Surface water

TABLE 2  
Field and Analytical Results—Groundwater Sampling  
October 2004, July 2005, and October 2005  
Oconomowoc Electroplating

Constituent	Units	WAC NR 140 PAL	WAC NR 140 ES	MW-001S			MW-004D	MW-005D	MW-012B	MW-012S			MW-012D			MW-013S	MW-013D			MW-014D		
				05CA05-01, 02 Oct 04	05CA40-08, 09 Jul 05	06CA01-26, 27 Oct 05	05CA40-13 Jul 05	05CA40-10 Jul 05	05CA40-43 Jul 05	05CA05-07, 08 Oct 04	05CA40-46, 47 Jul 05	06CA01-07, 08 Oct 05	05CA05-05, 06 Oct 04	05CA40-44, 45 Jul 05	06CA01-05, 06 Oct 05	05CA40-30 Jul 05	05CA05-09, 10 Oct 04	05CA40-22, 23 Jul 05	06CA01-32, 33 Oct 05	05CA05-11, 12 Oct 04	05CA40-16, 17 Jul 05	06CA01-09, 10 Oct 05
<b>Field Parameters</b>																						
Dissolved Oxygen (DO)	mg/L			1.82	28.8%	0.53	0.92	10.9%	10.2%	0.34	6.5%	1.32	0.18	7.6%	3.51	3.19	0.31	7.1%	0.36	0.45	1.24	0.59
Oxidation Reduction Potential (ORP)	millivolts			73.5	214.6		-55.7	28.6	29.8	14.8	68.7		-81.6	-71.7		241.4	-85.7	-69.2		43.4	15.1	
pH	pH units					135.1						324								-35.7		117.5
Specific Conductivity	mmhos/cm			6.93	6.51	6.64	7.81	6.51	7.77	7.26	7.15	4.62	7.33	7.08	6.37	6.42	7.16	7.12	6.43	7.28	7.02	6.87
Temperature	deg c			0.956	0.668	0.857	0.955	2.364	1.116	1.522	1.180	1.297	1.587	1.522	1.636	0.972	2.081	1.394	1.856	0.947	0.883	1.189
Depth to water	feet			16.34	15.88	17.78	11.97	13.53	17.40	12.84	13.76	15.15	11.05	13.52	12.28	12.39	12.35	11.99	11.86	13.20	11.99	14.64
				8.56	8.24		9.78	5.05	5.69	5.47	5.69		4.39	4.80		7.02	6.12	6.38		5.68	5.64	
<b>Natural Attenuation Parameters</b>																						
Alkalinity, total (as CaCO3)	mg/L	N/A	N/A	370	350	360				391	370	400	392	400	450		475	390	480	347	350	370
Chloride (as Cl)	mg/L	125	250	65.9	24	98				207	140	180	224	230	280		271	180	290	82.9	45	180
Ethane	µg/L	N/A	N/A	0.5 U	0.5 U	0.5 U				0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U		2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethene	µg/L	N/A	N/A	0.5 U	0.5 U	0.5 U				0.82 J	0.5 U	0.5 U	1.4 J	0.5 U	1.5		2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Iron, total	µg/L	150	300	281 J	468	377				499	300	264	2060	1210	1050		2180	983	2210	7 U	25.6 J	25 U
Iron, dissolved	µg/L	150	300	14 U	25 U	25 U				19.4 J	25 U	25 U	1010	993	875		2180	820	2030	14 U	25 U	25 U
Manganese, total	µg/L	25	50		15.2	11.9				114	121		31.5	28.2							81.6	105
Manganese, dissolved	µg/L	25	50	14.6	1.2 U	2 J				123	109	115	42.5	29.7	26.7		65.5	45.1	57.1	67	69.2	88.9
Methane	µg/L	N/A	N/A	2.3 J	0.5 U	1.4 J				130	32	1.4 J	31	43	87		66	17	34	14	4.3	2.3
Nitrogen, nitrate (as N)	mg/L	2	10	0.4 J	1	0.18				0.06 U	0.06 J	0.048 J	0.06 U	0.04 U	0.04 U		0.06 U	0.28	0.06 J	0.97 J	1.6	1.7
Sulfate (as SO4)	mg/L	125	250	47.2	24	35				60	220	62	85.2	93	84		225	93	190	32.4	40	45
Sulfide	mg/L	N/A	N/A	1 UJ	1 U	1 U				1 UJ	1 U	1 U	1 UJ	1 U	1 U		1 UJ	1 U	1 U	1 UJ	1 U	1 U
Total Organic Carbon	mg/L	N/A	N/A	1.6 J	1 J	2.2 J				4.7	3.3	3.5	4.6	4.1	5.6		4.9	2.2 J	4.2	2.7 J	1.4 J	1.8 J
<b>VOCs</b>																						
1,1,1-Trichloroethane	µg/L	40	200	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	66	74 J	57 J	25	12 J	43	0.18 J	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U
1,1,2,2-Tetrachloroethane	µg/L	0.02	0.2	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.36 U	0.36 U	0.018 U	0.09 U	0.45 U	0.018 UJ	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U
1,1,2-Trichloroethane	µg/L	0.5	5	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	1.8 U	1.8 U	0.09 U	0.45 U	2.3 U	0.09 UJ	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U
1,1-Dichloroethane	µg/L	85	850	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	17 J	0.031 U	43	25	31 J	46	0.082 J	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U
1,1-Dichloroethene	µg/L	0.7	7	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	3	0.06 U	7.1	5 J	6.4 J	3.9	1.1 J	0.06 UJ	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
1,2,3-Trichlorobenzene	µg/L	N/A	N/A	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	1.8 U	1.6 U	0.08 U	0.4 U	2 U	0.08 UJ	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
1,2,4-Trichlorobenzene	µg/L	14	70	0.06 U	0.06 UJ	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	1.2 U	1.2 U	0.06 U	0.3 U	1.5 U	0.06 UJ	0.06 U	0.06 U	0.06 U	0.06 U	0.06 UJ	0.06 U
1,2-Dibromo-3-chloropropane	µg/L	0.02	0.2	0.026 U	0.026 R	0.026 UJ	0.026 U	0.026 U	0.026 U	0.026 U	0.52 U	0.52 UJ	0.026 U	0.13 U	0.65 UJ	0.026 UJ	0.026 U	0.026 U	0.026 UJ	0.026 U	0.026 R	0.026 UJ
1,2-Dibromoethane	µg/L	0.5	5	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U	0.46 U	0.46 U	0.023 U	0.12 U	0.58 U	0.023 UJ	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U
1,2-Dichlorobenzene	µg/L	60	600	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.8 U	0.8 U	0.04 U	0.2 U	1 U	0.04 UJ	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
1,2-Dichloroethane	µg/L	0.5	5	0.04 U	0.04 U	0.04 U	0.04 U	1.3	0.04 U	0.04 U	0.8 U	0.8 U	0.04 U	0.2 U	1 U	0.04 UJ	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
1,2-Dichloropropane	µg/L	0.5	5	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	1.2 U	1.2 U	0.06 U	0.3 U	1.5 U	0.06 UJ	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
1,3-Dichlorobenzene	µg/L	125	1250	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.8 U	0.8 U	0.04 U	0.2 U	1 U	0.04 UJ	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
1,4-Dichlorobenzene	µg/L	15	75	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1 U	1 U	0.05 U	0.25 U	1.3 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
2-Butanone	µg/L	N/A	N/A	0.4 UJ	0.4 R	0.4 UJ	0.4 R	0.4 R	0.4 R	0.4 UJ	8 R	8 UJ	0.4 UJ	2 R	10 UJ	0.4 R	0.4 UJ	0.4 R	0.4 UJ	0.4 UJ	0.4 R	0.4 UJ
2-Hexanone	µg/L	N/A	N/A	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 UJ	10 U	0.5 U	2.5 UJ	13 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
4-Methyl-2-pentanone	µg/L	N/A	N/A	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 UJ	0.6 U	12 UJ	12 U	0.6 U	3 UJ	15 U	0.6 UJ	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U
Acetone	µg/L	200	1000	1.5 UJ	1.5 R	1.5 UJ	1.5 R	1.5 R	1.5 UJ	1.5 R	30 R	30 UJ	1.5 UJ	7.5 R	38 UJ	1.5 R	1.5 UJ	1.5 R	2.2 J	1.5 UJ	1.5 R	1.5 J
Benzene	µg/L	0.5	5	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.085 UB	1 U	1 U	0.069 UB	0.25 U	1.3 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Bromochloromethane	µg/L	N/A	N/A	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1 U	1 U	0.05 U	0.25 U	1.3 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Bromodichloromethane	µg/L	0.06	0.6	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.8 U	1.6 J	0.04 U	0.2 U	1.7 J	0.04 UJ	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Bromoform	µg/L	0.44	4.4	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	1.4 U	1.4 U	0.07 U	0.35 U	1.8 U	0.07 UJ	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U
Bromomethane	µg/L	1	10	0.06 U	0.06 UJ	0.06 U	0.06 UJ	0.06 UJ	0.06 UJ	0.06 U	1.2 U	1.2 U	0.06 U	0.3 U	1.5 U	0.06 UJ	0.06 U	0.06 UJ	0.06 U	0.06 U	0.06 UJ	0.06 U
Carbon disulfide	µg/L	200	1000	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	2 U	2 U	0.1 U	0.5 U	2.5 U	0.1 UJ	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U

TABLE 2  
 Field and Analytical Results—Groundwater Sampling  
 October 2004, July 2005, and October 2005  
 Oconomowoc Electroplating

Constituent	Units	WAC NR 140 PAL	WAC NR 140 ES	MW-001S		MW-004D	MW-005D	MW-012B	MW-012S			MW-012D		MW-013S	MW-013D			MW-014D				
				05CA05-01, 02 Oct 04	05CA40-08, 09 Jul 05	05CA01-26, 27 Oct 05	05CA40-13 Jul 05	05CA40-10 Jul 05	05CA40-43 Jul 05	05CA05-07, 08 Oct 04	05CA40-46, 47 Jul 05	06CA01-07, 08 Oct 05	05CA05-05, 06 Oct 04	05CA40-44, 45 Jul 05	06CA01-05, 06 Oct 05	05CA40-30 Jul 05	05CA05-09, 10 Oct 04	05CA40-22, 23 Jul 05	06CA01-32, 33 Oct 05	05CA05-11, 12 Oct 04	05CA40-16, 17 Jul 05	06CA01-09, 10 Oct 05
VOCs Continued																						
Carbon tetrachloride	µg/L	0.5	5	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1 U	1 U	0.05 U	0.25 U	1.3 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Chlorobenzene	µg/L	N/A	N/A	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1 U	1 U	0.05 U	0.25 U	1.3 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Chloroethane	µg/L	80	400	0.06 U	0.06 U	0.06 U	0.06 U	2.2 J	0.06 U	0.6 J	1.2 U	1.2 U	0.16 J	0.3 U	1.5 U	0.06 UJ	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
Chloroform	µg/L	0.6	6	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.1 UB	1.7 J	1.4 U	0.07 U	0.35 U	1.8 U	0.07 UJ	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U
Chloromethane	µg/L	0.3	3	0.05 U	0.05 UJ	0.22 UB	0.05 UJ	0.05 UJ	0.05 U	0.05 U	1 U	1 U	0.05 U	0.25 U	1.3 U	0.05 UJ	0.05 U	0.24	0.48	0.05 U	0.05 UJ	0.38 UB
cis-1,2-Dichloroethene	µg/L	7	70	0.06 U	0.06 U	0.06 U	0.06 U	250	0.06 U	29	17 J	64 J	13	7.1	30	0.14 J	0.21 J	0.26	0.38	0.06 U	0.06 U	0.06 U
cis-1,3-Dichloropropene	µg/L	0.02	0.2	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.32 U	0.32 U	0.016 U	0.08 U	0.4 U	0.016 UJ	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U
Dibromochloromethane	µg/L	6	60	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	1.8 U	1.8 U	0.09 U	0.45 U	2.3 U	0.09 UJ	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U
Dichlorodifluoromethane	µg/L	200	1000	0.06 U	0.06 UJ	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	1.2 U	1.2 U	0.06 U	0.3 U	1.5 U	0.06 UJ	0.06 U	0.06 U	0.06 U	0.06 U	0.06 UJ	0.06 U
Ethylbenzene	µg/L	140	700	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1 U	1 U	0.05 U	0.25 U	1.3 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Isopropylbenzene	µg/L	N/A	N/A	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.6 U	0.6 U	0.03 U	0.15 U	0.75 U	0.03 UJ	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
m,p-Xylene (sum of isomers)	µg/L	1000	10000	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	2.4 U	2.4 U	0.12 U	0.6 U	3 U	0.12 UJ	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
Methyl tert-butyl ether	µg/L	12	60	0.15 J	0.05 U	0.14 J	0.05 U	0.22 J	0.05 U	0.05 U	1 U	1 U	0.05 U	0.25 U	1.3 U	0.05 UJ	0.05 U	0.28	0.16 J	0.05 U	0.05 U	0.05 U
Methylene chloride	µg/L	0.5	5	0.11 UJ	0.11 UJ	1.8 J	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	2.2 UJ	70 J	0.11 UJ	0.55 UJ	77 J	0.11 UJ	0.11 UJ	0.11 UJ	2.1 J	0.11 UJ	0.11 UJ	2.1 J
o-Xylene	µg/L	N/A	N/A	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.8 U	0.8 U	0.04 U	0.2 U	1 U	0.04 UJ	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Styrene	µg/L	10	100	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.8 U	0.8 U	0.04 U	0.2 U	1 U	0.04 UJ	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Tetrachloroethene	µg/L	0.5	5	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.051 J	1 U	1 U	0.05 U	0.25 U	1.3 U	0.097 J	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Toluene	µg/L	200	1000	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	1.6 U	1.6 U	0.08 U	0.4 U	2 U	0.08 UJ	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
trans-1,2-Dichloroethene	µg/L	20	100	0.04 U	0.04 U	0.04 U	0.04 U	9.7 J	0.04 U	16 J	16 J	20 J	3.2	1.6 J	10	0.04 UJ	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
trans-1,3-Dichloropropene	µg/L	0.02	0.2	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.3 U	0.3 U	0.015 U	0.075 U	0.38 U	0.015 UJ	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U
Trichloroethene	µg/L	0.5	5	0.07 J	0.03 U	0.031 J	0.03 U	180	0.03 U	120	100	100 J	10	3.8	27	0.33 J	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.041 J
Vinyl chloride	µg/L	0.02	0.2	0.018 U	0.018 U	0.018 U	0.018 U	3.8	0.018 U	0.38	0.36 U	4.4 J	3	2.4 J	5.7	0.018 UJ	0.23	0.028	0.2	0.018 U	0.018 U	0.018 U



TABLE 2  
Field and Analytical Results—Groundwater Sampling  
October 2004, July 2005, and October 2005  
Ocanomawoc Electroplating

Constituent	Units	WAC NR 140 PAL	WAC NR 140 ES	MW-015B	MW-015S			MW-015D			MW-016S		MW-101B	MW-102D	MW-103S			MW-103D			
				05CA40-01 Jul 05	05CA05-15, 16 Oct 04	05CA40-04, 05 Jul 05	06CA01-11, 12 Oct 05	05CA05-13, 14 Oct 04	05CA40-02, 03 Jul 05	06CA01-15, 16 Oct 05	05CA05-17, 18 Oct 04	04CA40-35, 36 Jul 05	06CA01-28, 29 Oct 05	05CA40-14 Jul 05	05CA40-15 Jul 05	05CA05-21, 22 Oct 04	05CA40-26, 27 Jul 05	06CA01-03, 04 Oct 05	05CA05-19, 20 Oct 04	05CA40-24, 25 Jul 05	06CA01-01, 02 Oct 05
<b>Field Parameters</b>																					
Dissolved Oxygen (DO)	mg/L			9.7%	8.47	93.9%	5.33	0.43	0.79	1.46	3.33	5.6%	0.17	0.58	8.1%	0.38	0.96	0.77	0.35	6.5%	1.59
Oxidation Reduction Potential (ORP)	millivolts			-43.9	72.0	28.1		60.5	258.2		-157.8	75.1		-35.7	23.6	197.7	205.3		24.8	98.2	
pH	pH units			6.86	7.46	7.24	7.02	7.12	6.27	6.46	7.03	6.69	6.23	7.02	6.88	6.95	6.44	6.63	7.12	7.04	5.95
Specific Conductivity	mmhos/cm			0.898	0.480	0.621	0.831	1.832	1.447	1.354	3.293	3.459	3.623	1.167	1.470	1.249	1.462	1.381	1.565	1.373	1.1
Temperature	deg c			14.96	15.83	14.97	16.7	14.20	13.95	14.33	12.87	15.14	14.02	13.23	13.79	16.17	14.39	18.14	14.35	13.41	16.84
Depth to water	feet			9.34	10.43	10.21		11.31	11.62		4.17	4.93		7.14	9.83	7.60	7.56		7.73	7.67	
<b>Natural Attenuation Parameters</b>																					
Alkalinity, total (as CaCO <sub>3</sub> )	mg/L	N/A	N/A		229	300	330	422	370	400	930	840	930			445	450	450	452	410	440
Chloride (as Cl)	mg/L	125	250		9.86 J	32	90	291	200	220	155	170	220			218	160	190	200	170	180
Ethane	µg/L	N/A	N/A		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.8 J	1.3 J	0.56 J			0.5 U	0.5 U	0.5 U	0.6 J	0.5 U	0.5 U
Ethene	µg/L	N/A	N/A		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	12	4.1	4.3			0.5 U	0.5 U	0.5 U	0.96 J	0.5 U	0.5 U
Iron, total	µg/L	150	300		224 J	59.7 J	95.3	7.2 J	25 UJ	170 J	6450	8260	6590			154	69.9 J	39.8 J	29.6	25 U	25 U
Iron, dissolved	µg/L	150	300		14 U	25 U	25 U	14 U	25 U	25 U	5830	7420	6130			139	43.6 J	30.4 J	14 U	25 U	25 U
Manganese, total	µg/L	25	50		8.2	29.2		276	257	257	78.1	85				395	351	354	283	272	255 J
Manganese, dissolved	µg/L	25	50		9.6	1.2 U	7.7	314	250	254	81.5	71.2	79.2			402	375	354	283	272	255 J
Methane	µg/L	N/A	N/A		1 J	0.5 U	0.84 J	4.6 J	1.4 J	1.8 J	680	530	180			7.5 J	62	24	72	73	79
Nitrogen, nitrate (as N)	mg/L	2	10		4.65 J	0.8	0.92	0.16 J	0.18	0.29	0.06 U	0.052 J	0.08 J			0.19 J	0.28	0.05 J	0.06 UJ	0.04 U	0.05 J
Sulfate (as SO <sub>4</sub> )	mg/L	125	250		13.1 J	15	22	43.8	43	49	941 J	1000	1300			128	74	72	60	47	45
Sulfide	mg/L	N/A	N/A		1 UJ	1 U	1 U	1 UJ	1 U	1 U	1 UJ	1 U	1 U			1 UJ	1 U	1 U	1 UJ	1 U	1 U
Total Organic Carbon	mg/L	N/A	N/A		1.5 J	2 J	1.9 J	3.3	2.5 J	2.4 J	5	3.9	3.7			6.6	6.1	5.8	5.3	3.7	4.1
<b>VOCs</b>																					
1,1,1-Trichloroethane	µg/L	40	200	0.07 U	1.1	0.39 J	1.5	0.07 U	0.35 U	0.35 U	0.07 U	1.8 U	3.5 U	0.07 U	0.07 UJ	140	150	200	480	450 J	460
1,1,2,2-Tetrachloroethane	µg/L	0.02	0.2	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.09 U	0.09 U	0.018 U	0.45 U	0.9 U	0.018 U	0.018 UJ	0.018 U	0.9 U	0.9 U	0.018 U	9 U	1.8 U
1,1,2-Trichloroethane	µg/L	0.5	5	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.45 U	0.45 U	0.09 U	2.3 U	4.5 U	0.09 U	0.09 UJ	0.09 U	4.5 U	4.5 U	0.7	45 U	9 U
1,1-Dichloroethane	µg/L	85	850	0.031 U	0.031 U	0.031 U	0.031 U	0.13 J	0.16 U	0.16 U	0.067 J	0.78 U	1.6 U	0.031 U	0.031 UJ	7.6	16 J	22	120	89 J	76
1,1-Dichloroethene	µg/L	0.7	7	0.06 U	0.06 U	0.06 U	0.06 U	0.3	0.3 U	0.3 U	0.12 J	1.5 U	3 U	0.06 U	0.06 UJ	3.5	6.9 J	10	80	85 J	73
1,2,3-Trichlorobenzene	µg/L	N/A	N/A	0.08 U	0.08 U	0.08 U	0.08 U	0.4 U	0.4 U	0.4 U	0.08 U	2 U	4 U	0.08 U	0.08 U	0.08 U	4 UJ	4 U	0.08 U	40 UJ	8 U
1,2,4-Trichlorobenzene	µg/L	14	70	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.3 U	0.3 U	0.06 U	1.5 U	3 U	0.06 U	0.06 U	0.06 U	3 UJ	3 U	0.06 U	30 UJ	6 U
1,2-Dibromo-3-chloropropane	µg/L	0.02	0.2	0.026 U	0.026 U	0.026 U	0.026 U	0.13 U	0.13 UJ	0.026 U	0.65 U	1.3 UJ	0.026 U	0.026 U	0.026 U	1.3 R	1.3 UJ	0.026 U	13 R	2.6 UJ	
1,2-Dibromoethane	µg/L	0.5	5	0.023 U	0.023 U	0.023 U	0.023 U	0.12 U	0.12 U	0.023 U	0.58 U	1.2 U	0.023 U	0.023 U	0.023 U	1.2 U	1.2 U	0.023 U	12 U	2.3 U	
1,2-Dichlorobenzene	µg/L	60	600	0.04 U	0.04 U	0.04 U	0.04 U	0.2 U	0.2 U	0.2 U	0.04 U	1 U	2 U	0.04 U	0.04 U	0.04 U	2 U	2 U	0.04 U	20 U	4 U
1,2-Dichloroethane	µg/L	0.5	5	0.04 U	0.04 U	0.04 U	0.16 J	0.2 U	0.2 U	0.2 U	0.54	1 U	2 U	0.04 U	0.071 J	0.26	2 U	2 U	0.75	20 U	4 U
1,2-Dichloropropane	µg/L	0.5	5	0.06 U	0.06 U	0.06 U	0.06 U	0.3 U	0.3 U	0.3 U	0.06 U	1.5 U	3 U	0.06 U	0.06 UJ	0.06 U	3 U	3 U	0.06 U	30 U	6 U
1,3-Dichlorobenzene	µg/L	125	1250	0.04 U	0.04 U	0.04 U	0.04 U	0.2 U	0.2 U	0.2 U	0.04 U	1 U	2 U	0.04 U	0.04 U	0.04 U	2 U	2 U	0.04 U	20 U	4 U
1,4-Dichlorobenzene	µg/L	15	75	0.05 U	0.05 U	0.05 U	0.05 U	0.25 U	0.25 U	0.25 U	0.05 U	1.3 U	2.5 U	0.05 U	0.05 U	0.05 U	2.5 U	2.5 U	0.05 U	25 U	5 U
2-Butanone	µg/L	N/A	N/A	0.4 R	0.4 UJ	0.4 R	0.4 U	0.4 UJ	2 R	2 UJ	0.4 UJ	10 R	20 UJ	0.4 R	0.4 R	0.4 UJ	20 R	20 UJ	0.4 UJ	200 R	40 UJ
2-Hexanone	µg/L	N/A	N/A	0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	2.5 U	2.5 U	0.5 U	13 U	25 U	0.5 U	0.5 UJ	0.5 U	25 U	25 J	0.5 U	250 U	50 U
4-Methyl-2-pentanone	µg/L	N/A	N/A	0.6 U	0.6 U	0.6 U	0.6 U	3 U	3 U	3 U	0.6 U	15 U	30 U	0.6 U	0.6 UJ	0.6 U	30 U	30 U	0.6 U	300 U	60 U
Acetone	µg/L	200	1000	1.5 R	1.5 UJ	1.5 R	1.5 U	1.5 UJ	7.5 R	7.5 UJ	1.5 UJ	38 R	75 UJ	1.5 R	1.5 R	1.5 UJ	75 R	75 UJ	1.5 UJ	750 R	150 UJ
Benzene	µg/L	0.5	5	0.05 U	0.05 U	0.05 U	0.05 U	0.11 UB	0.25 U	0.25 U	0.05 U	1.3 U	3.2 J	0.05 U	0.05 U	0.096 UB	2.5 U	2.5 U	0.18 UB	25 U	5 U
Bromochloromethane	µg/L	N/A	N/A	0.05 U	0.05 U	0.05 U	0.05 U	0.25 U	0.25 U	0.25 U	0.05 U	1.3 U	2.5 U	0.05 U	0.05 U	0.05 U	2.5 U	2.5 U	0.05 U	25 U	5 U
Bromodichloromethane	µg/L	0.06	0.6	0.04 U	0.04 U	0.04 U	0.04 U	0.2 U	0.2 U	0.2 U	0.04 U	1.1 J	2.1 J	0.04 U	0.04 UJ	0.04 U	2 U	2.5 J	0.04 U	34 J	4.9 J
Bromoform	µg/L	0.44	4.4	0.07 U	0.07 U	0.07 U	0.07 U	0.35 U	0.35 U	0.35 U	0.07 U	1.8 UJ	3.5 U	0.07 U	0.07 U	3.5 UJ	3.5 UJ	0.07 U	35 UJ	7 U	
Bromomethane	µg/L	1	10	0.06 UJ	0.06 UJ	0.06 UJ	0.06 U	0.3 UJ	0.3 U	0.3 U	0.06 U	1.5 U	3 U	0.06 UJ	0.06 UJ	0.06 U	3 UJ	3 U	0.06 U	30 UJ	6 U
Carbon disulfide	µg/L	200	1000	0.1 U	0.1 U	0.1 U	0.1 U	0.5 U	0.5 U	0.5 U	0.1 U	2.5 U	5 U	0.13 UB	0.1 U	0.1 U	5 U	5 U	0.1 U	50 U	10 U

TABLE 2  
 Field and Analytical Results—Groundwater Sampling  
 October 2004, July 2005, and October 2005  
 Oconomowoc Electroplating

Constituent	Units	WAC NR 140 PAL	WAC NR 140 ES	MW-015B		MW-015S			MW-015D			MW-016S		MW-101B	MW-102D	MW-103S			MW-103D		
				05CA40-01 Jul 05	05CA05-15, 16 Oct 04	05CA40-04, 05 Jul 05	06CA01-11, 12 Oct 05	05CA05-13, 14 Oct 04	05CA40-02, 03 Jul 05	06CA01-15, 16 Oct 05	05CA05-17, 18 Oct 04	04CA40-35, 36 Jul 05	06CA01-28, 29 Oct 05	05CA40-14 Jul 05	05CA40-15 Jul 05	05CA05-21, 22 Oct 04	05CA40-26, 27 Jul 05	06CA01-03, 04 Oct 05	05CA05-19, 20 Oct 04	05CA40-24, 25 Jul 05	06CA01-01, 02 Oct 05
VOCs Continued																					
Carbon tetrachloride	µg/L	0.5	5	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.25 U	0.25 U	0.05 U	1.3 U	2.5 U	0.05 U	0.05 UJ	0.05 U	2.5 U	2.5 U	0.05 U	25 U	5 U
Chlorobenzene	µg/L	N/A	N/A	0.05 U	0.05 U	0.05 U	0.05 U	4.1	3.3	4	0.05 U	1.3 U	2.5 U	0.05 U	0.05 UJ	3.5	3 J	5.7 J	0.073 J	25 U	5 U
Chloroethane	µg/L	80	400	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.3 U	0.3 U	0.06 U	1.5 U	3 U	0.06 U	0.06 UJ	0.37 J	3 U	3 U	0.98 J	30 U	6 U
Chloroform	µg/L	0.6	6	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.35 U	0.35 U	0.07 U	1.8 U	3.5 U	0.07 U	0.07 UJ	0.24 UB	3.5 U	3.5 U	1.2 UB	35 U	7 U
Chloromethane	µg/L	0.3	3	0.05 UJ	0.05 U	0.05 U	0.32	0.05 U	0.25 U	0.5 J	0.05 U	1.3 U	2.5 U	0.05 U	0.05 UJ	0.05 U	2.5 U	2.5 U	0.05 U	25 U	5 U
cis-1,2-Dichloroethene	µg/L	7	70	0.06 U	0.06 U	0.06 U	0.06 U	6	2.5 J	4.3	190	330	790	0.18 J	12 J	21	47 J	59	360	280 J	270
cis-1,3-Dichloropropene	µg/L	0.02	0.2	0.016 U	0.016 U	0.016 U	0.016 U	0.08 U	0.08 U	0.016 U	0.4 U	0.8 U	0.016 U	0.016 UJ	0.016 U	0.8 U	0.8 U	0.016 U	8 U	1.6 U	
Dibromochloromethane	µg/L	6	60	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.45 U	0.45 U	0.09 U	2.3 U	4.5 U	0.09 U	0.09 UJ	0.09 U	4.5 U	4.5 U	0.09 U	45 U	9 U
Dichlorodifluoromethane	µg/L	200	1000	0.06 U	0.06 U	0.06 U	0.06 U	0.3 U	0.3 U	0.06 U	1.5 U	3 U	0.06 U	0.06 U	0.06 U	3 UJ	3 U	0.06 U	30 UJ	6 U	
Ethylbenzene	µg/L	140	700	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.25 U	0.25 U	0.05 U	1.3 U	2.5 U	0.05 U	0.05 UJ	0.05 U	2.5 U	2.5 U	0.05 U	25 U	5 U
Isopropylbenzene	µg/L	N/A	N/A	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.15 U	0.15 U	0.03 U	0.75 U	1.5 U	0.03 U	0.03 U	0.03 U	1.5 U	1.5 U	0.03 U	15 U	3 U
m,p-Xylene (sum of isomers)	µg/L	1000	10000	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.6 U	0.6 U	0.12 U	3 U	6 U	0.12 U	0.12 U	0.12 U	6 U	6 U	0.12 U	60 U	12 U
Methyl tert-butyl ether	µg/L	12	60	0.05 U	0.05 U	0.05 U	0.05 U	0.69 J	0.25 U	0.4 J	0.05 U	1.3 U	2.5 U	0.29 J	0.45 J	0.05 U	2.5 U	2.5 U	0.05 U	25 U	5 U
Methylene chloride	µg/L	0.5	5	0.11 UJ	0.11 UJ	0.11 UJ	2.1	0.11 UJ	0.55 UJ	15 J	0.11 UJ	2.8 UJ	130 J	0.11 UJ	0.11 UJ	0.11 UJ	5.5 UJ	120 J	0.11 UJ	55 UJ	270 J
o-Xylene	µg/L	N/A	N/A	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.2 U	0.2 U	0.04 U	1 U	2 U	0.04 U	0.04 U	0.04 U	2 U	2 U	0.04 U	20 U	4 U
Styrene	µg/L	10	100	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.2 U	0.2 U	0.04 U	1 U	2 U	0.04 U	0.04 UJ	0.04 U	2 U	2 U	0.04 U	20 U	4 U
Tetrachloroethene	µg/L	0.5	5	0.05 U	0.05 U	0.05 U	0.05 U	0.25 U	0.25 U	0.05 U	1.3 U	2.5 U	0.05 U	0.05 UJ	1.4	2.5 U	2.5 U	0.05 U	25 U	5 U	
Toluene	µg/L	200	1000	0.08 U	0.08 U	0.08 U	0.08 U	0.4 U	0.4 U	0.08 U	2 U	4 U	0.08 U	0.08 UJ	0.08 U	4 U	4 U	0.08 U	40 U	8 U	
trans-1,2-Dichloroethene	µg/L	20	100	0.04 U	0.04 U	0.04 U	0.04 U	0.6 J	0.3	0.4 J	5	6.2 J	7.9	0.04 U	0.6 J	0.35 J	2 U	2 U	5.5	20 U	4 U
trans-1,3-Dichloropropene	µg/L	0.02	0.2	0.015 U	0.015 U	0.015 U	0.015 U	0.075 U	0.075 U	0.015 U	0.38 U	0.75 U	0.015 U	0.015 UJ	0.015 U	0.75 U	0.75 U	0.015 U	7.5 U	1.5 U	
Trichloroethene	µg/L	0.5	5	0.03 U	0.15 J	0.03 U	0.03 U	41	30	40	0.03 U	0.75 J	1.5 U	0.03 U	0.76 J	200	230	340	2200	2000	2200
Vinyl chloride	µg/L	0.02	0.2	0.018 U	0.018 U	0.018 U	0.018 U	0.074	0.09 U	0.09 U	85	58	170	0.018 U	0.018 U	0.4	0.9 U	1.2 J	2.9	9 U	4.1 J

TABLE 2  
Field and Analytical Results—Groundwater Sampling  
October 2004, July 2005, and October 2005  
Oconomoc Electroplating

Constituent	Units	WAC NR 140 PAL	WAC NR 140 ES	MW-105B	MW-105S				MW-105D			MW-106S	MW-106D	PW-01	PW-02	PW-03	PW-04	PW-05	PW-07	PW-08	PW-09	PW-10	PW-11
				05CA40-32 Jul 05	05CA05-25, 26 Oct 04	05CA40-20, 21 Jul 05	06CA01-19, 20 Oct 05	05CA05-23, 24 Oct 04	04CA40-33, 34 Jul 05	06CA01-17, 18 Oct 05	05CA40-07 Jul 05	05CA40-12 Jul 05	05CA40-48 Jul 05	05CA40-49 Jul 05	05CA40-56 Jul 05	05CA40-50 Jul 05	05CA40-51 Jul 05	05CA40-52 Jul 05	05CA40-57 Jul 05	05CA40-53 Jul 05	05CA40-54 Jul 05	05CA40-58 Jul 05	
<b>Field Parameters</b>																							
Dissolved Oxygen (DO)	mg/L			0.86	0.19	11.9%	5.27	6.09	1.04	0.48	10.1%	0.97	4.5	2.94	5.51	9.2	4.69	2.79	3.41	6.27	6.22	3.29	
Oxidation Reduction Potential (ORP)	millivolts			-51.8	-32.8	-50.1	70.2	-56.3	-15.3		23.1	-66.7	-80.8	-77.2	-101.8	-82.7	-62.1	-90	-70.9	-82.6	-32.6	-74.4	
pH	pH units			6.45	7.31	7.02	6.21	7.34	5.86	6.69	6.79	7.09	6.8	6.77	7.02	7.28	7.16	6.92	6.73	6.97	6.76	6.62	
Specific Conductivity	mmhos/cm			1.105	1.620	1.714	1.414	1.299	1.411	1.472	0.960	1.231	0.674	0.64	0.985	1.033	0.962	1.237	1.243	1.101	1.069	0.989	
Temperature	deg c			12.90	12.98	12.71	14.86	12.10	11.08	13.93	11.81	10.94	14.36	15.66	12.89	13.75	12.98	14.09	13.79	14.33	15.61	13.63	
Depth to water	feet			5.08	5.16	5.55		5.01	5.51	5.80	5.40												
<b>Natural Attenuation Parameters</b>																							
Alkalinity, total (as CaCO3)	mg/L	N/A	N/A	367	370	390	362	400	420														
Chloride (as Cl)	mg/L	125	250	281	290	250	159	200	250														
Ethane	µg/L	N/A	N/A	1.4 J	0.5 U	0.5 U	0.62 J	0.5 U	1.4 J														
Ethene	µg/L	N/A	N/A	0.61 J	0.5 U	0.5 U	0.8 J	0.5 U	1.5														
Iron, total	µg/L	150	300	384	930	540	845 J	1090	1050														
Iron, dissolved	µg/L	150	300	338	557	287	863 J	984	974														
Manganese, total	µg/L	25	50	241	198		89.5	81.6 J															
Manganese, dissolved	µg/L	25	50	227	229	197	67.5	66.4	82.2 J														
Methane	µg/L	N/A	N/A	110	42	0.59 J	1900	170	150														
Nitrogen, nitrate (as N)	mg/L	2	10	0.06 UJ	0.04 U	0.048 J	0.06 UJ	0.05 J	0.04 U														
Sulfate (as SO4)	mg/L	125	250	77.5	68	66	75.9	58	74														
Sulfide	mg/L	N/A	N/A	1 UJ	1.3 J	1 J	1 UJ	1 J	1 U														
Total Organic Carbon	mg/L	N/A	N/A	3.5	2.6 J	4.1	4.1	3.7	3.5														
<b>VOCs</b>																							
1,1,1-Trichloroethane	µg/L	40	200	0.07 UJ	0.64 J	0.45 J	1.1 J	0.5 J	1.4 U	1.4 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	
1,1,2,2-Tetrachloroethane	µg/L	0.02	0.2	0.018 UJ	0.018 U	0.018 U	0.18 U	0.018 U	0.36 U	0.36 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	
1,1,2-Trichloroethane	µg/L	0.5	5	0.09 U	0.09 U	0.09 U	0.9 U	0.09 U	1.8 U	1.8 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	
1,1-Dichloroethane	µg/L	85	850	0.095 J	4.8	6.5	14	16	15 J	140	0.031 U	0.031 U	0.039	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	
1,1-Dichloroethene	µg/L	0.7	7	0.06 U	0.94	0.52	2	2.6	2.4 J	14	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	
1,2,3-Trichlorobenzene	µg/L	N/A	N/A	0.08 U	0.08 U	0.08 U	0.8 U	0.08 U	1.6 U	1.6 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	
1,2,4-Trichlorobenzene	µg/L	14	70	0.06 U	0.06 U	0.06 U	0.6 U	0.06 U	1.2 U	1.2 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	
1,2-Dibromo-3-chloropropane	µg/L	0.02	0.2	0.026 U	0.026 U	0.026 U	0.26 UJ	0.026 U	0.52 U	0.52 UJ	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	
1,2-Dibromoethane	µg/L	0.5	5	0.023 UJ	0.023 U	0.023 U	0.23 U	0.023 U	0.46 U	0.46 U	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U	0.023 U	
1,2-Dichlorobenzene	µg/L	60	600	0.04 U	0.04 U	0.04 U	0.4 U	0.04 U	0.8 U	0.8 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	
1,2-Dichloroethane	µg/L	0.5	5	0.04 UJ	0.04 U	0.04 U	0.4 U	0.17 J	0.8 U	0.8 U	0.04 U	0.04 U	0.13 J	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	
1,2-Dichloropropane	µg/L	0.5	5	0.06 UJ	0.06 U	0.06 U	0.6 U	0.06 U	1.2 U	1.2 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	
1,3-Dichlorobenzene	µg/L	125	1250	0.04 U	0.04 U	0.04 U	0.4 U	0.04 U	0.8 U	0.8 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	
1,4-Dichlorobenzene	µg/L	15	75	0.05 U	0.05 U	0.05 U	0.5 U	0.05 U	1 U	1 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	
2-Butanone	µg/L	N/A	N/A	0.4 R	0.4 UJ	0.4 R	4 UJ	0.4 UJ	8 R	8 UJ	0.4 R	0.4 R	0.4 R	0.4 R	0.4 R	0.4 R	0.4 R	0.4 R	0.4 R	0.4 R	0.4 R	0.4 R	
2-Hexanone	µg/L	N/A	N/A	0.5 UJ	0.5 U	0.5 U	5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	
4-Methyl-2-pentanone	µg/L	N/A	N/A	0.6 UJ	0.6 U	0.6 U	6 U	0.6 U	12 U	12 U	0.6 U	0.6 U	0.6 UJ	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	
Acetone	µg/L	200	1000	1.5 R	1.5 UJ	1.5 R	15 UJ	1.5 UJ	30 UJ	30 UJ	1.5 R	1.5 R	1.5 R	1.5 R	1.5 R	1.5 R	1.5 R	1.5 R	1.5 R	1.5 R	1.5 R	1.5 R	
Benzene	µg/L	0.5	5	0.05 U	0.056 UB	0.05 U	0.5 U	0.05 U	1 U	1 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	
Bromochloromethane	µg/L	N/A	N/A	0.05 U	0.05 U	0.05 U	0.5 U	0.05 U	1 U	1 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	
Bromodichloromethane	µg/L	0.06	0.6	0.04 U	0.04 U	0.04 U	0.4 U	0.04 U	0.8 U	1.1 J	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	
Bromofom	µg/L	0.44	4.4	0.07 UJ	0.07 U	0.07 UJ	0.7 U	0.07 U	1.4 UJ	1.4 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	
Bromomethane	µg/L	1	10	0.06 UJ	0.06 U	0.06 U	0.6 U	0.06 U	1.2 U	1.2 U	0.06 UJ	0.06 UJ	0.06 U	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	
Carbon disulfide	µg/L	200	1000	0.12 J	0.1 U	0.1 U	1 U	0.1 U	2 U	2 U	0.1 U	0.1 U	0.1 U	0.21 J	0.1 U	0.13 J	0.11 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	

TABLE 2  
Field and Analytical Results—Groundwater Sampling  
October 2004, July 2005, and October 2005  
Oconomowoc Electroplating

Constituent	Units	WAC NR 140 PAL	WAC NR 140 ES	MW-105B	MW-105S				MW-105D			MW-106S	MW-106D	PW-01	PW-02	PW-03	PW-04	PW-05	PW-07	PW-08	PW-09	PW-10	PW-11
				05CA40-32 Jul 05	05CA05-25, 26 Oct 04	05CA40-20, 21 Jul 05	06CA01-19, 20 Oct 05	05CA05-23, 24 Oct 04	04CA40-33, 34 Jul 05	06CA01-17, 18 Oct 05	05CA40-07 Jul 05	05CA40-12 Jul 05	05CA40-48 Jul 05	05CA40-49 Jul 05	05CA40-56 Jul 05	05CA40-50 Jul 05	05CA40-51 Jul 05	05CA40-52 Jul 05	05CA40-57 Jul 05	05CA40-53 Jul 05	05CA40-54 Jul 05	05CA40-58 Jul 05	
VOCs Continued																							
Carbon tetrachloride	µg/L	0.5	5	0.05 UJ	0.05 U	0.05 U	0.5 U	0.05 U	1 U	1 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 UJ	0.05 U	0.05 UJ	0.05 UJ	0.05 UJ
Chlorobenzene	µg/L	N/A	N/A	0.05 U	0.6	0.58	0.98 J	0.05 U	1 U	1 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Chloroethane	µg/L	80	400	0.06 UJ	0.06 U	0.06 U	0.6 U	0.06 U	1.2 U	1.7 J	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
Chloroform	µg/L	0.6	6	0.07 U	0.07 U	0.07 U	0.7 U	0.07 U	1.4 U	1.4 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.18 J	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U
Chloromethane	µg/L	0.3	3	0.05 U	0.05 U	0.05 U	0.5 U	0.05 U	1 U	1 U	0.05 U	0.05 UJ	0.05 U	0.05 U	0.064 J	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
cis-1,2-Dichloroethene	µg/L	7	70	0.18 J	58	69	160	56	29	350	0.06 U	0.06 U	0.06 U	0.06 U	0.58 J	0.97 J	1.4	2.3	1.3	4.4	0.06 U	0.41 J	0.41 J
cis-1,3-Dichloropropene	µg/L	0.02	0.2	0.016 U	0.016 U	0.016 U	0.16 U	0.016 U	0.32 U	0.32 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U
Dibromochloromethane	µg/L	6	60	0.09 U	0.09 U	0.09 U	0.9 U	0.09 U	1.8 U	1.8 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U
Dichlorodifluoromethane	µg/L	200	1000	0.06 U	0.06 U	0.06 U	0.6 U	0.06 U	1.2 U	1.2 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
Ethylbenzene	µg/L	140	700	0.05 U	0.05 U	0.05 U	0.5 U	0.05 U	1 U	1 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Isopropylbenzene	µg/L	N/A	N/A	0.03 U	0.03 U	0.03 U	0.3 U	0.03 U	0.6 U	0.6 U	0.03 U	0.03 U	0.03 U	0.03 U	0.19 J	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
m,p-Xylene (sum of isomers)	µg/L	1000	10000	0.12 U	0.12 U	0.12 U	1.2 U	0.12 U	2.4 U	2.4 U	0.12 U	0.12 U	0.12 U	0.12 U	1.3 J	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
Methyl tert-butyl ether	µg/L	12	60	0.05 U	0.17 J	0.33 J	0.5 U	0.05 U	1 U	1 U	0.05 U	0.05 U	0.05 U	0.05 U	0.64	1	0.57	0.6	0.74	0.13 J	0.13 J	0.13 J	0.13 J
Methylene chloride	µg/L	0.5	5	0.11 UJ	0.11 UJ	0.11 UJ	1.1 UJ	0.11 UJ	2.2 UJ	2.2 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ
o-Xylene	µg/L	N/A	N/A	0.04 U	0.04 U	0.04 U	0.4 U	0.04 U	0.8 U	0.8 U	0.04 U	0.04 U	0.04 U	0.04 U	1.6 J	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Styrene	µg/L	10	100	0.04 U	0.04 U	0.04 U	0.4 U	0.04 U	0.8 U	0.8 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Tetrachloroethene	µg/L	0.5	5	0.05 U	0.05 U	0.05 U	0.5 U	0.05 U	1 U	1 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Toluene	µg/L	200	1000	0.08 U	0.08 U	0.08 U	0.8 U	0.08 U	1.6 U	1.6 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
trans-1,2-Dichloroethene	µg/L	20	100	0.04 U	0.71 J	1.6	1.8	2.6	1	11	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.075 J	0.12 J	0.19 J	0.078 J	0.36 J	0.04 U	0.043 J
trans-1,3-Dichloropropene	µg/L	0.02	0.2	0.015 U	0.015 U	0.015 U	0.15 U	0.015 U	0.3 UJ	0.3 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U
Trichloroethene	µg/L	0.5	5	0.09 J	63	76	41	240	130	470	0.03 U	0.03 U	0.03 U	0.03 U	0.42	0.03 U	0.11 J	0.03 U	0.17 J	0.064 J	0.03 U	0.03 U	
Vinyl chloride	µg/L	0.02	0.2	0.059	2.3	2.3	3.7	1.5	1.1	9.2	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.042 J	0.018 U	0.05 J	0.018 U	0.018 U

J indicates that the value was between the method detection limit and the limit of quantitation and, therefore, is estimated.  
 U indicates that the constituent was not detected above the method detection limit.  
 UJ indicates that the constituent was not detected above the estimated method detection limit.  
 R indicates that the initial calibration report associated with this SDG contained relative response factors (RRFs) lower than 0.05 for acetone, 2-Butanone and 1,2-dibromo-3-chloropropane.  
 Non-detected concentrations were qualified and flagged "R" as rejected.  
 UB indicates that the constituent is considered to be below the detection limit listed due to blank contamination.  
 Bolded values indicate attainment or exceedance of the Wisconsin Administrative Code (WAC) NR 140 Preventative Action Limit (PAL).  
 Shaded values indicate attainment or exceedance of the Wisconsin Administrative Code (WAC) NR 140 Enforcement Standard (ES).

**TABLE 3**  
Groundwater Elevations  
*Oconomowoc Electroplating*

Well ID	Top of Casing Elevation (ftamsl)	Water Level		Water Level Depth July 11, 2005	Groundwater Elevation July 11, 2005	Water Level Depth October 3, 2005	Groundwater Elevation October 3, 2005
		Depth October __, 2004	Groundwater Elevation October __, 2004				
MW-1S	853.42	8.56	844.86	8.24	845.18	9.66	843.76
MW-1D	853.14	8.18	844.96	7.74	845.4	9.72	843.42
MW-2D	852.36	7.21	845.15	7.28	845.08	8.75	843.61
MW-3S	853.39	NM	NM	dry	dry	dry	dry
MW-3D	853.51	9.47	844.04	NM	well casing compromised	10.92	842.59
MW-4S	854.58	9.90	844.68	9.63	844.95	11.40	843.18
MW-4D	852.08	10.28	841.8	9.78	842.3	11.62	840.46
MW-5	848.35			NM	Likely compro-mised, outer casing visibly damaged	NM	Likely compro- mised, outer casing visibly damaged
		4.97	843.38				
MW-5D	847.28	4.81	842.47	5.05	842.23	5.99	841.29
MW-9S	849.30	7.19	842.11	7.07	842.23	8.19	841.11
MW-12S	849.17	5.47	843.7	5.69	843.48	6.43	842.74
MW-12D	848.31	4.39	843.92	4.8	843.51	5.66	842.65
MW-12B	849.40	5.46	843.94	5.69	843.71	6.82	842.58
MW-13S	850.91	6.83	844.08	7.02	843.89	8.07	842.84
MW-13D	850.02	6.12	843.9	6.38	843.64	7.30	842.72
MW-14D	850.58	5.88	844.7	5.64	844.94	11.62	838.96
MW-15S	854.68	10.43	844.25	10.21	844.47	11.73	842.95
MW-15D	855.30	11.31	843.99	11.62	843.68	12.74	842.56
MW-15B	854.35	10.25	844.1	9.34	845.01	15.33	839.02
MW-16S	847.90	4.17	843.73	4.93	842.97	5.25	842.65
MW-101S	851.24	6.60	844.64	6.3	844.94	8.09	843.15
MW-101B	851.08	6.92	844.16	7.14	843.94	8.42	842.66
MW-102S	853.65	9.52	844.13	9.3	844.35	10.94	842.71
MW-102D	853.70	9.94	843.76	9.83	843.87	11.11	842.59
MW-103S	851.84	7.60	844.24	7.56	844.28	8.68	843.16
MW-103D	851.97	7.73	844.24	7.67	844.3	8.80	843.17

**TABLE 3**Groundwater Elevations  
*Oconomowoc Electroplating*

Well ID	Top of Casing Elevation (ftamsl)	Water Level	Groundwater	Water Level Depth	Groundwater	Water Level	Groundwater
		Depth October __, 2004	Elevation October __, 2004	July 11, 2005	Elevation July 11, 2005	Depth October 3, 2005	Elevation October 3, 2005
MW-104S	850.56	6.39	844.17	6.39	844.17	7.27	843.29
MW-104D	850.57	7.35	843.22	6.45	844.12	7.58	842.99
MW-105S	849.01	5.16	843.85	5.55	843.46	6.18	842.83
MW-105D	848.90	5.01	843.89	5.51	843.39	6.27	842.63
MW-105B	848.90	5.60	843.3	5.08	843.82	6.30	842.60
MW-106S	848.92	5.71	843.21	5.8	843.12	6.86	842.06
MW-106D	849.01	5.23	843.78	5.4	843.61	6.44	842.57

Note: NM = Not Measured

**TABLE 4**  
 Screening for Anaerobic Biodegradation Processes and Interpretation of Screening Results  
*Oconomowoc Electroplating*

Analysis	Preferred Concentration Indicating Anaerobic Biodegradation <sup>a</sup>	Interpretation <sup>a</sup>	Value <sup>a</sup>	Points Awarded for Study Area <sup>a,b,c</sup>
Oxygen (mg/L)	< 0.5 mg/L	Tolerated, suppresses the reductive pathway at higher concentrations.	3	3
Oxygen (mg/L)	> 5 mg/L	Not tolerated, however, VC may be oxidized aerobically.	-3	0
Nitrate (mg/L)	< 1 mg/L	At higher concentrations, may compete with reductive pathway.	2	2
Iron II <sup>d</sup>	> 1 mg/L	Reductive pathway possible; VC may be oxidized under Fe (III)-reducing conditions.	3	3
Sulfate (mg/L)	< 20 mg/L	At higher concentrations, may compete with reductive pathway.	2	0
Sulfide (mg/L)	> 1 mg/L	Reductive pathway possible.	3	0
Methane (mg/L)	< 0.5 mg/L	VC oxidizes.	0	0
Methane (mg/L)	> 0.5 mg/L	Ultimate reductive daughter product, VC accumulates.	3	0
Oxidation Reduction Potential (mV)	< 50 mV	Reductive pathway possible.	1	1
Oxidation Reduction Potential (mV)	< -100 mV	Reductive pathway likely.	2	0
pH	5 < pH < 9	Optimal range for reductive pathway.	0	0
pH	5 > pH > 9	Outside optimal range for reductive pathway.	-2	0
TOC (mg/L)	> 20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic.	2	0
Temperature (degrees Celsius)	> 20C	At T .20C, biochemical process is accelerated.	1	0
Alkalinity (mg/L)	> 2x background	Results from interaction between CO2 and aquifer materials.	1	0
Chloride (mg/L)	> 2x background	Daughter product of organic chlorine.	2	2
BTEX (mg/L)	> 0.1 mg/L	Carbon and energy source; drives dechlorination.	2	0
Trichloroethene (mg/L)	Not applicable	Material released.		0
Dichloroethene (mg/L)	Not applicable	Daughter product of TCE; If cis is > 80% of total DCE it is likely a daughter product, 1,1DCE can be chemical reaction product of TCA.	2	2
Vinyl chloride (mg/L)	Not applicable	Daughter product of DCE.	2	2

TABLE 4

Screening for Anaerobic Biodegradation Processes and Interpretation of Screening Results  
*Oconomowoc Electroplating*

Analysis	Preferred Concentration Indicating Anaerobic Biodegradation <sup>a</sup>	Interpretation <sup>a</sup>	Value <sup>a</sup>	Points Awarded for Study Area <sup>a,b,c</sup>
1,1,1-trichloroethane (mg/L)	Not applicable	Material released.		0
1,1-dichloroethane (mg/L)	Not applicable	Daughter product of TCA under reducing conditions.	2	2
Chloroethane (mg/L)	Not applicable	Daughter product of DCA or VC under reducing conditions.	2	0
Ethene/Ethane (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	2
Ethene/Ethane (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0
			SCORE: <sup>a,e</sup>	19

<sup>a</sup> See Table 2.3 in Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water, EPA/600/R-98/128.

<sup>b</sup> See Table 1 of this report for study area constituent values.

<sup>c</sup> Points awarded only when 50 percent or more of results for a particular parameter for the wells sampled were at the preferred concentration.

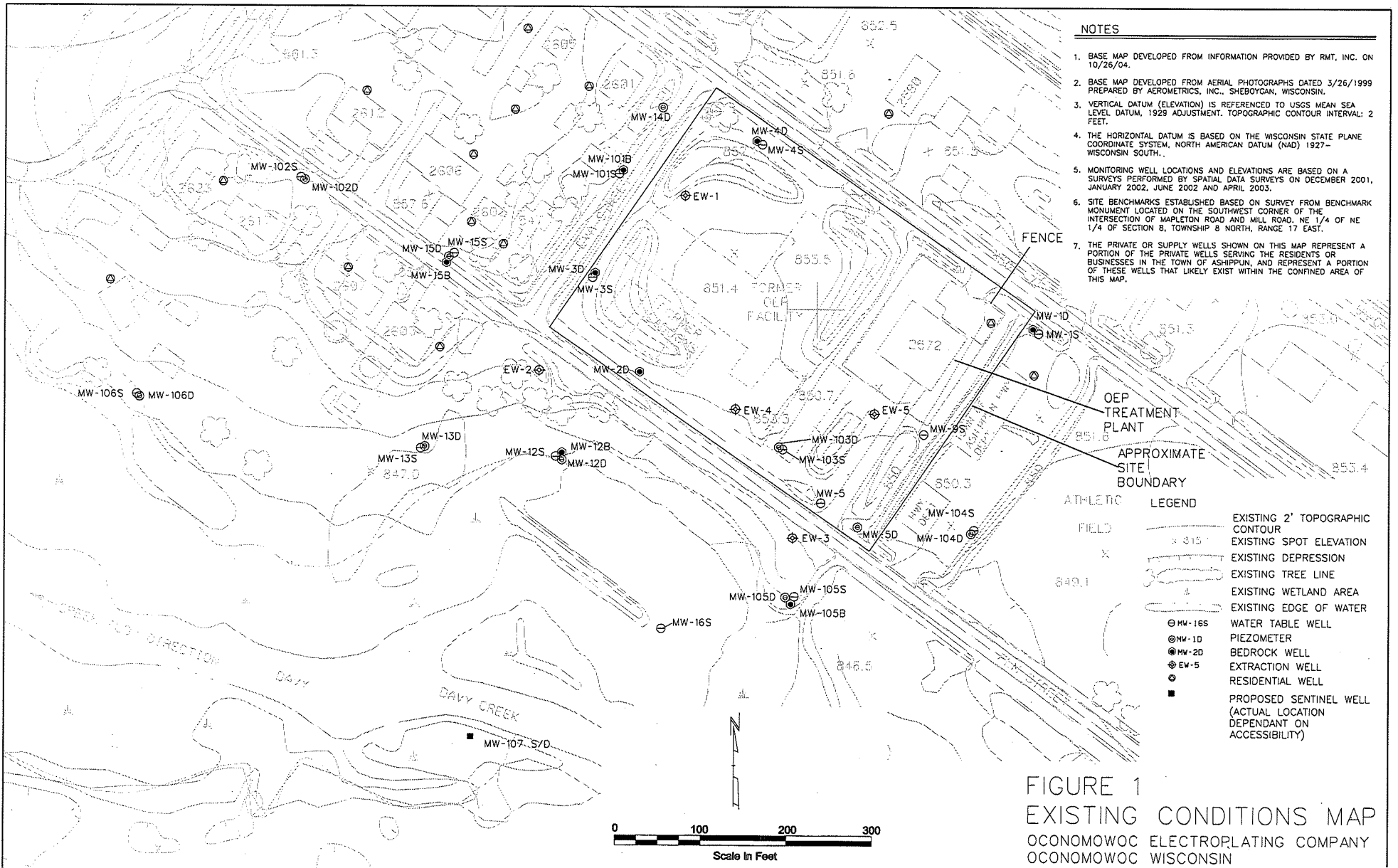
<sup>d</sup> Sampled for dissolved iron. Compared values to background concentrations (>2x background).

<sup>e</sup> Scores of 15 to 20 = Adequate evidence for anaerobic biodegradation of CVOCs.



## Figures

---



- NOTES**
1. BASE MAP DEVELOPED FROM INFORMATION PROVIDED BY RMT, INC. ON 10/26/04.
  2. BASE MAP DEVELOPED FROM AERIAL PHOTOGRAPHS DATED 3/26/1999 PREPARED BY AEROMETRICS, INC., SHEBOYGAN, WISCONSIN.
  3. VERTICAL DATUM (ELEVATION) IS REFERENCED TO USGS MEAN SEA LEVEL DATUM, 1929 ADJUSTMENT. TOPOGRAPHIC CONTOUR INTERVAL: 2 FEET.
  4. THE HORIZONTAL DATUM IS BASED ON THE WISCONSIN STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927 - WISCONSIN SOUTH.
  5. MONITORING WELL LOCATIONS AND ELEVATIONS ARE BASED ON A SURVEYS PERFORMED BY SPATIAL DATA SURVEYS ON DECEMBER 2001, JANUARY 2002, JUNE 2002 AND APRIL 2003.
  6. SITE BENCHMARKS ESTABLISHED BASED ON SURVEY FROM BENCHMARK MONUMENT LOCATED ON THE SOUTHWEST CORNER OF THE INTERSECTION OF MAPLETON ROAD AND MILL ROAD, NE 1/4 OF NE 1/4 OF SECTION 8, TOWNSHIP 8 NORTH, RANGE 17 EAST.
  7. THE PRIVATE OR SUPPLY WELLS SHOWN ON THIS MAP REPRESENT A PORTION OF THE PRIVATE WELLS SERVING THE RESIDENTS OR BUSINESSES IN THE TOWN OF ASHPILUN, AND REPRESENT A PORTION OF THESE WELLS THAT LIKELY EXIST WITHIN THE CONFINED AREA OF THIS MAP.

- LEGEND**
- EXISTING 2' TOPOGRAPHIC CONTOUR
  - x 315' EXISTING SPOT ELEVATION
  - - - EXISTING DEPRESSION
  - EXISTING TREE LINE
  - EXISTING WETLAND AREA
  - EXISTING EDGE OF WATER
  - MW-16S WATER TABLE WELL
  - ⊙ MW-1D PIEZOMETER
  - ⊙ MW-2D BEDROCK WELL
  - ⊙ EW-5 EXTRACTION WELL
  - ⊙ RESIDENTIAL WELL
  - PROPOSED SENTINEL WELL (ACTUAL LOCATION DEPENDANT ON ACCESSIBILITY)

**FIGURE 1**  
**EXISTING CONDITIONS MAP**  
 OCONOMOWOC ELECTROPLATING COMPANY  
 OCONOMOWOC WISCONSIN

ED12005008MKE

SW

NE

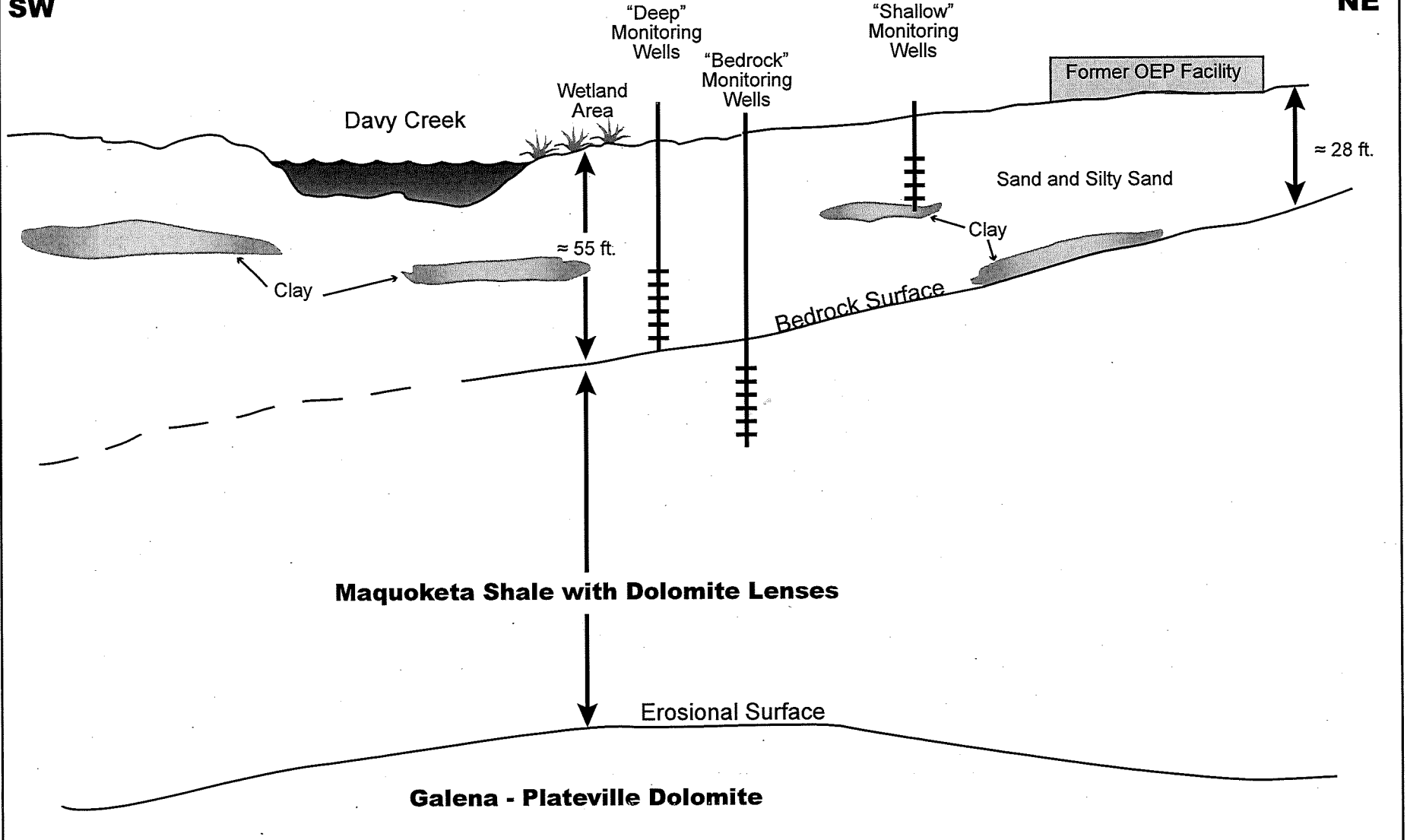
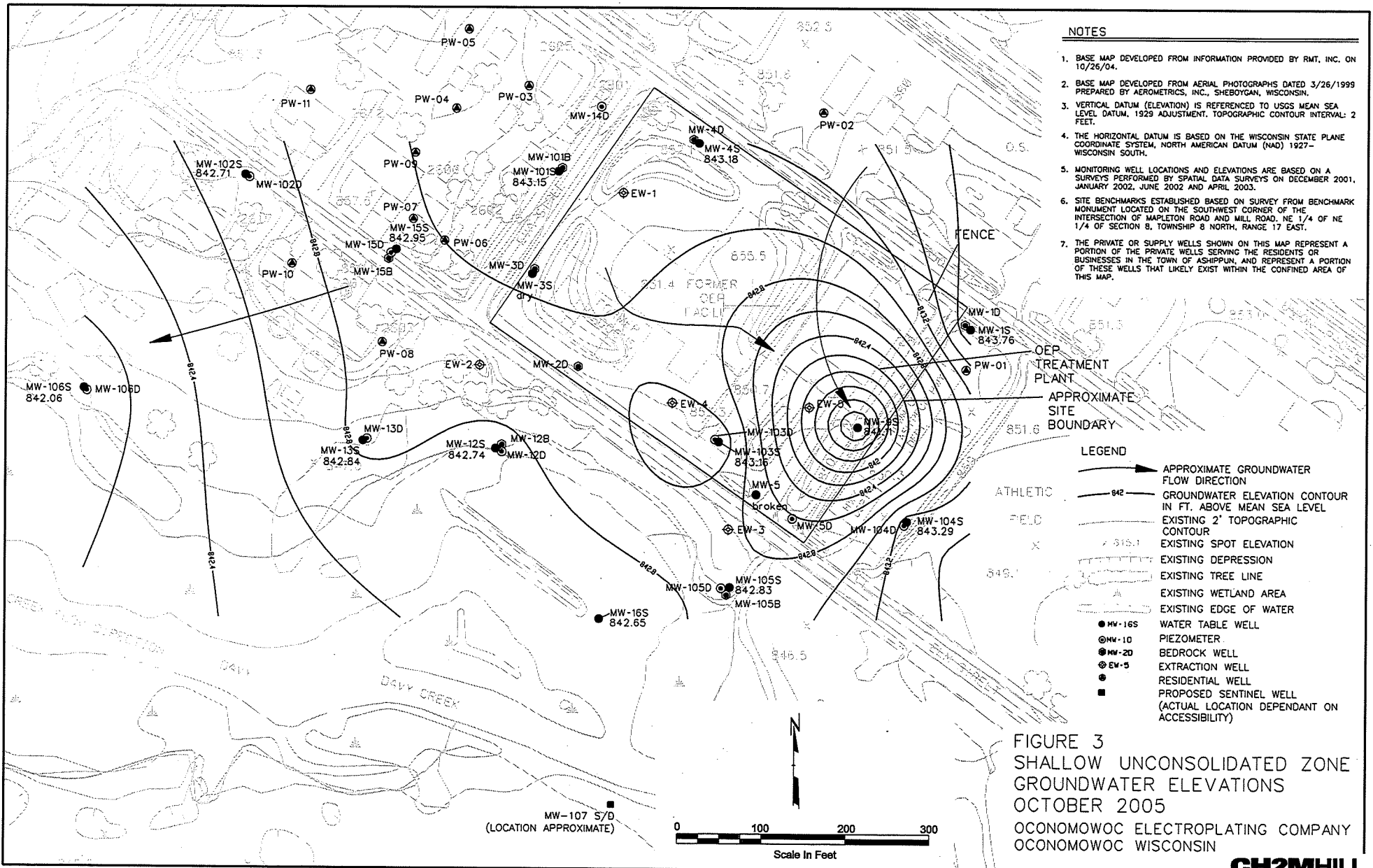
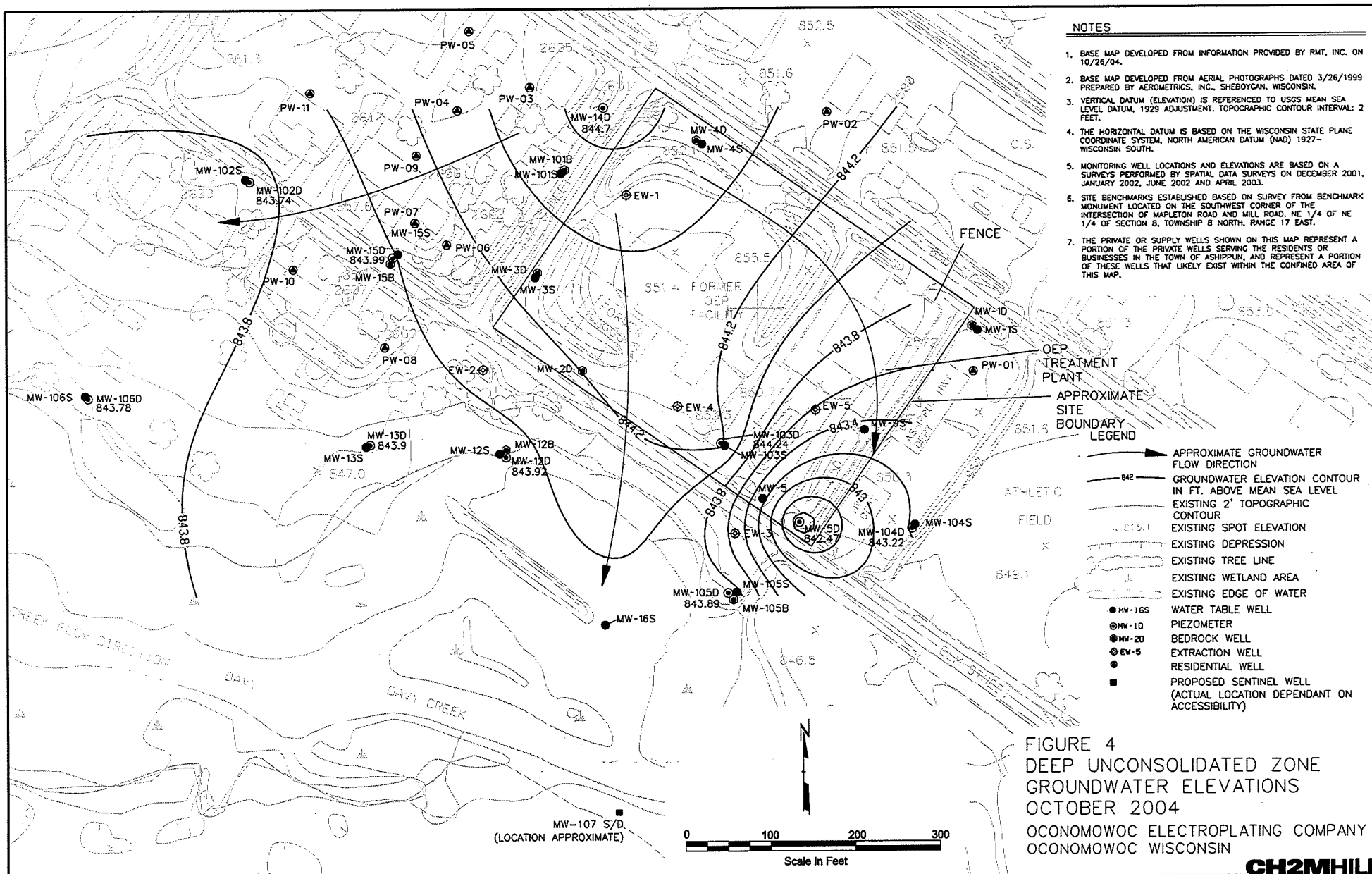
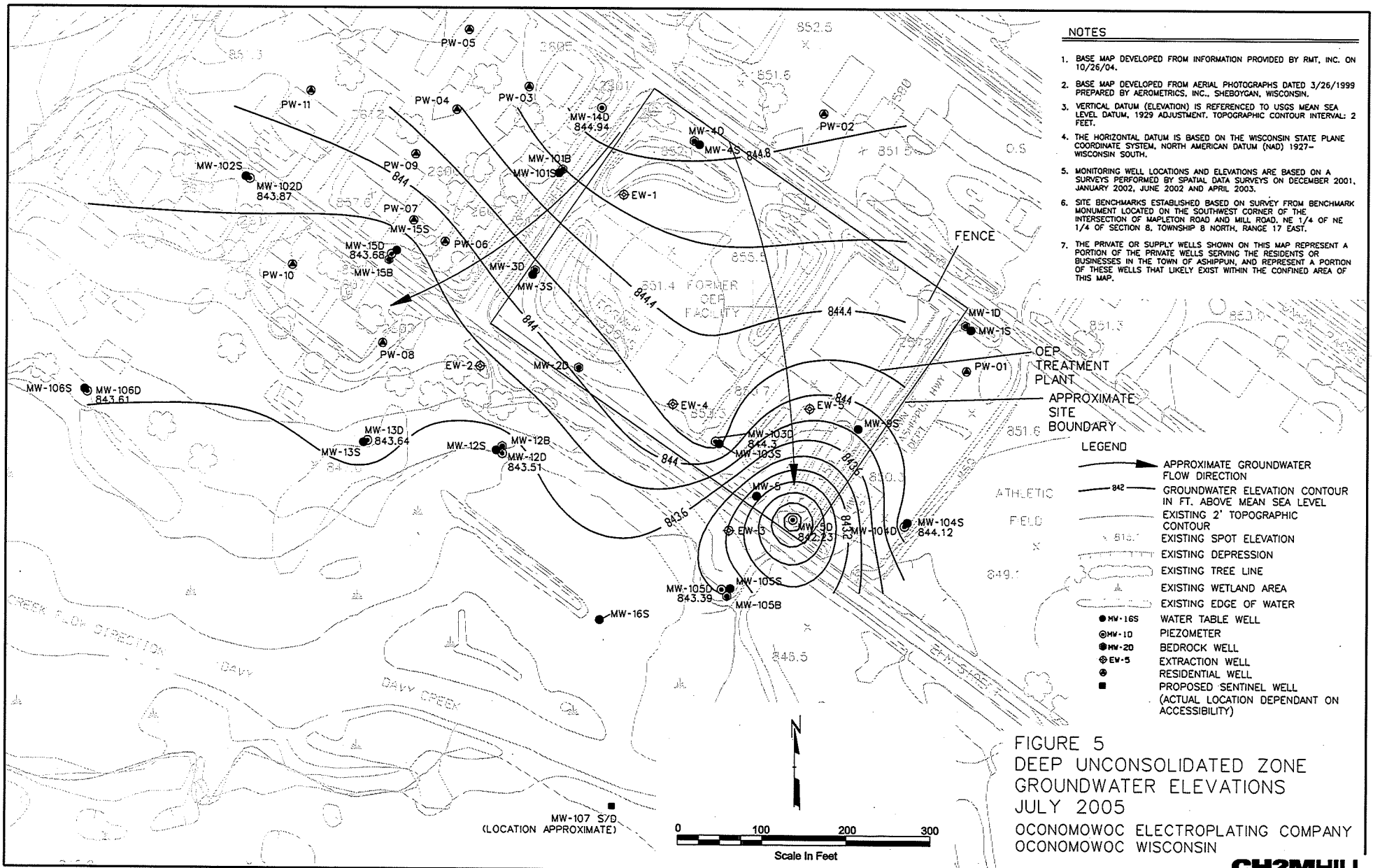
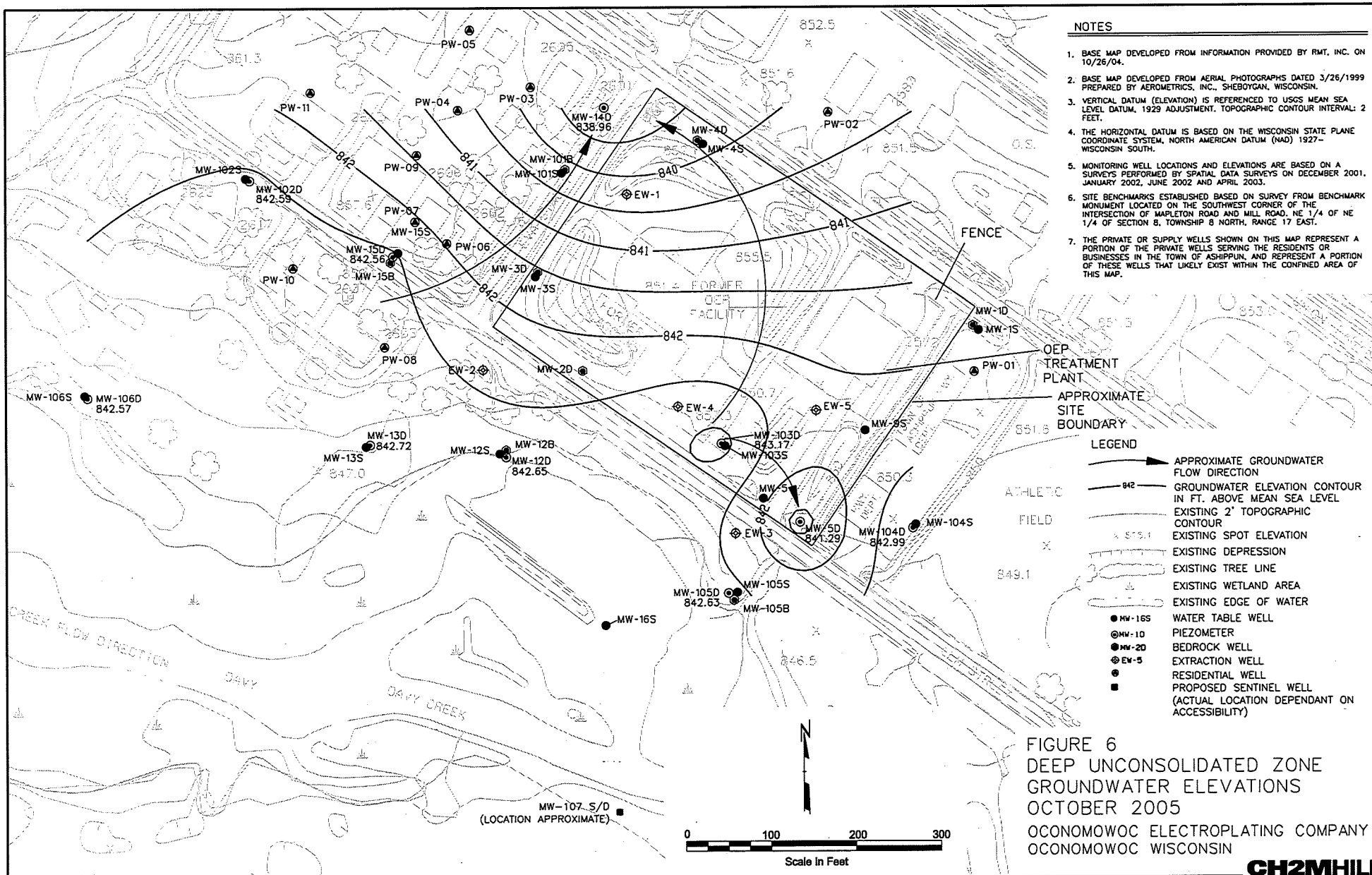


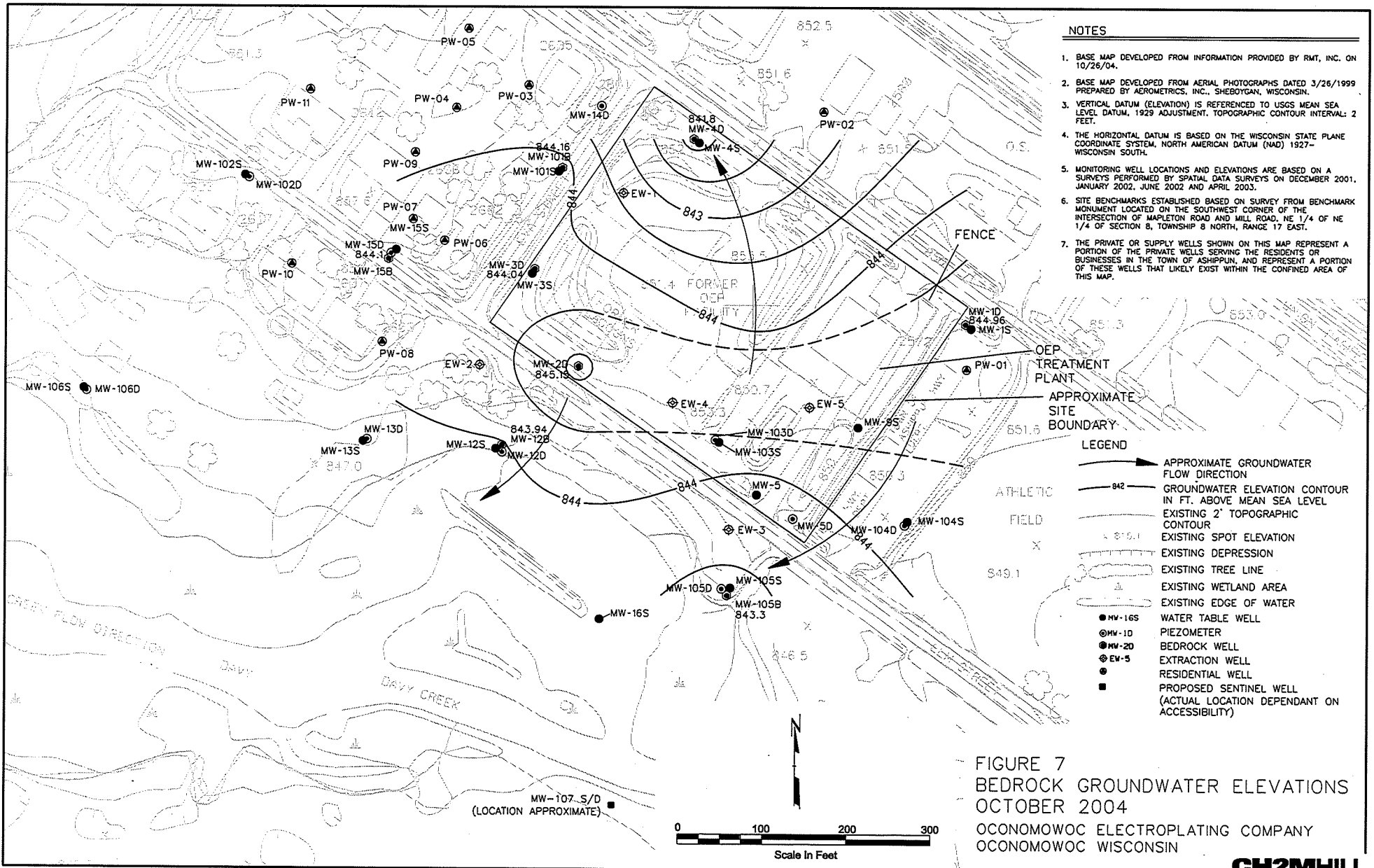
Figure 2  
**Conceptual Depiction of Site Aquifer  
Units and Well Placement**  
Oconomowoc Electroplating Company  
Oconomowoc, WI











**NOTES**

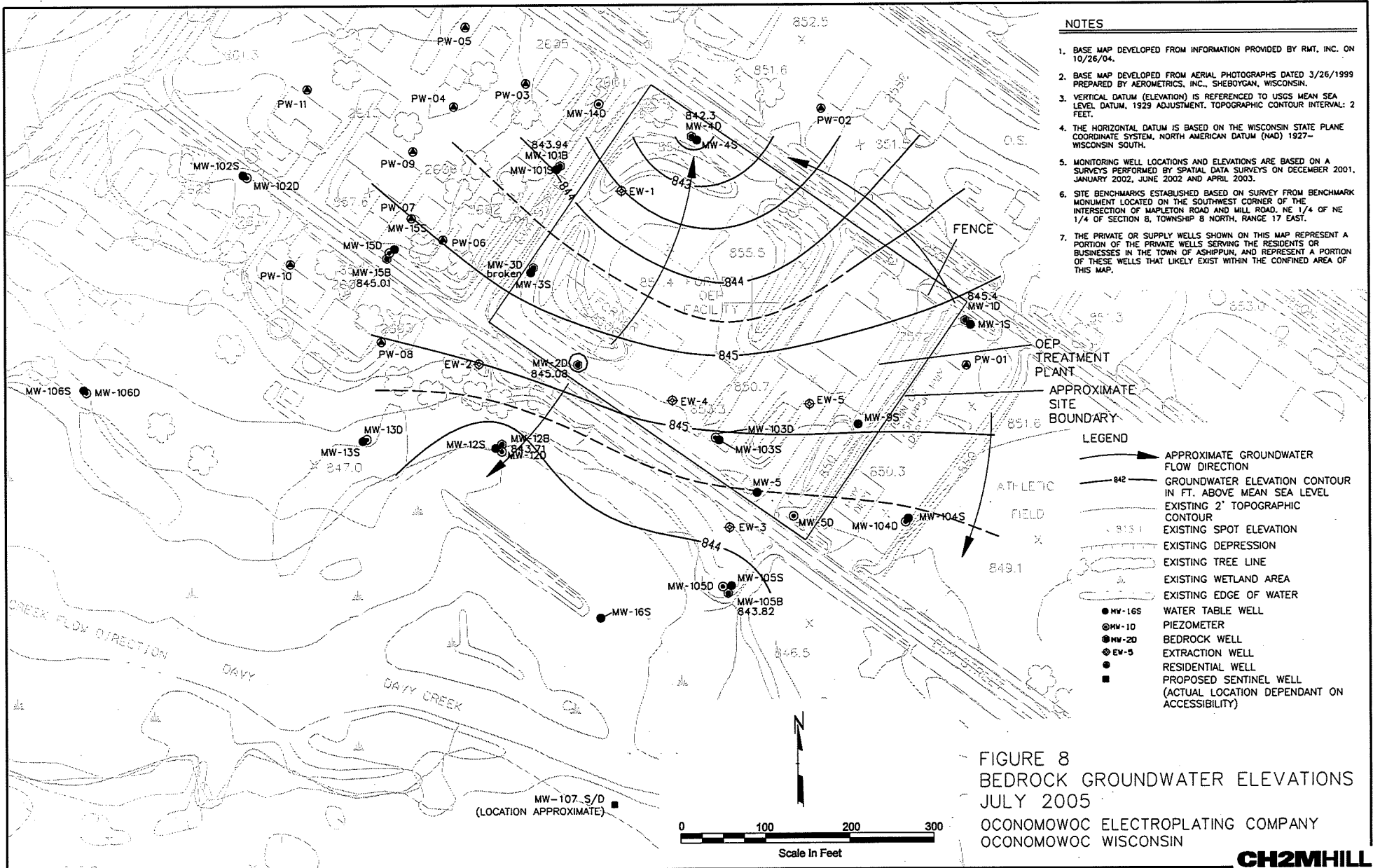
1. BASE MAP DEVELOPED FROM INFORMATION PROVIDED BY RMT, INC. ON 10/26/04.
2. BASE MAP DEVELOPED FROM AERIAL PHOTOGRAPHS DATED 3/26/1999 PREPARED BY AEROMETRICS, INC., SHEBOYGAN, WISCONSIN.
3. VERTICAL DATUM (ELEVATION) IS REFERENCED TO USGS MEAN SEA LEVEL DATUM, 1929 ADJUSTMENT. TOPOGRAPHIC CONTOUR INTERVAL: 2 FEET.
4. THE HORIZONTAL DATUM IS BASED ON THE WISCONSIN STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927- WISCONSIN SOUTH.
5. MONITORING WELL LOCATIONS AND ELEVATIONS ARE BASED ON A SURVEYS PERFORMED BY SPATIAL DATA SURVEYS ON DECEMBER 2001, JANUARY 2002, JUNE 2002 AND APRIL 2003.
6. SITE BENCHMARKS ESTABLISHED BASED ON SURVEY FROM BENCHMARK MONUMENT LOCATED ON THE SOUTHWEST CORNER OF THE INTERSECTION OF MAPLETON ROAD AND MILL ROAD, NE 1/4 OF NE 1/4 OF SECTION 8, TOWNSHIP 8 NORTH, RANGE 17 EAST.
7. THE PRIVATE OR SUPPLY WELLS SHOWN ON THIS MAP REPRESENT A PORTION OF THE PRIVATE WELLS SERVING THE RESIDENTS OR BUSINESSES IN THE TOWN OF ASHIPPUN, AND REPRESENT A PORTION OF THESE WELLS THAT LIKELY EXIST WITHIN THE CONFINED AREA OF THIS MAP.

**LEGEND**

- APPROXIMATE GROUNDWATER FLOW DIRECTION
- GROUNDWATER ELEVATION CONTOUR IN FT. ABOVE MEAN SEA LEVEL
- EXISTING 2' TOPOGRAPHIC CONTOUR
- EXISTING SPOT ELEVATION
- EXISTING DEPRESSION
- EXISTING TREE LINE
- EXISTING WETLAND AREA
- EXISTING EDGE OF WATER
- WATER TABLE WELL
- PIEZOMETER
- BEDROCK WELL
- EXTRACTION WELL
- RESIDENTIAL WELL
- PROPOSED SENTINEL WELL (ACTUAL LOCATION DEPENDANT ON ACCESSIBILITY)

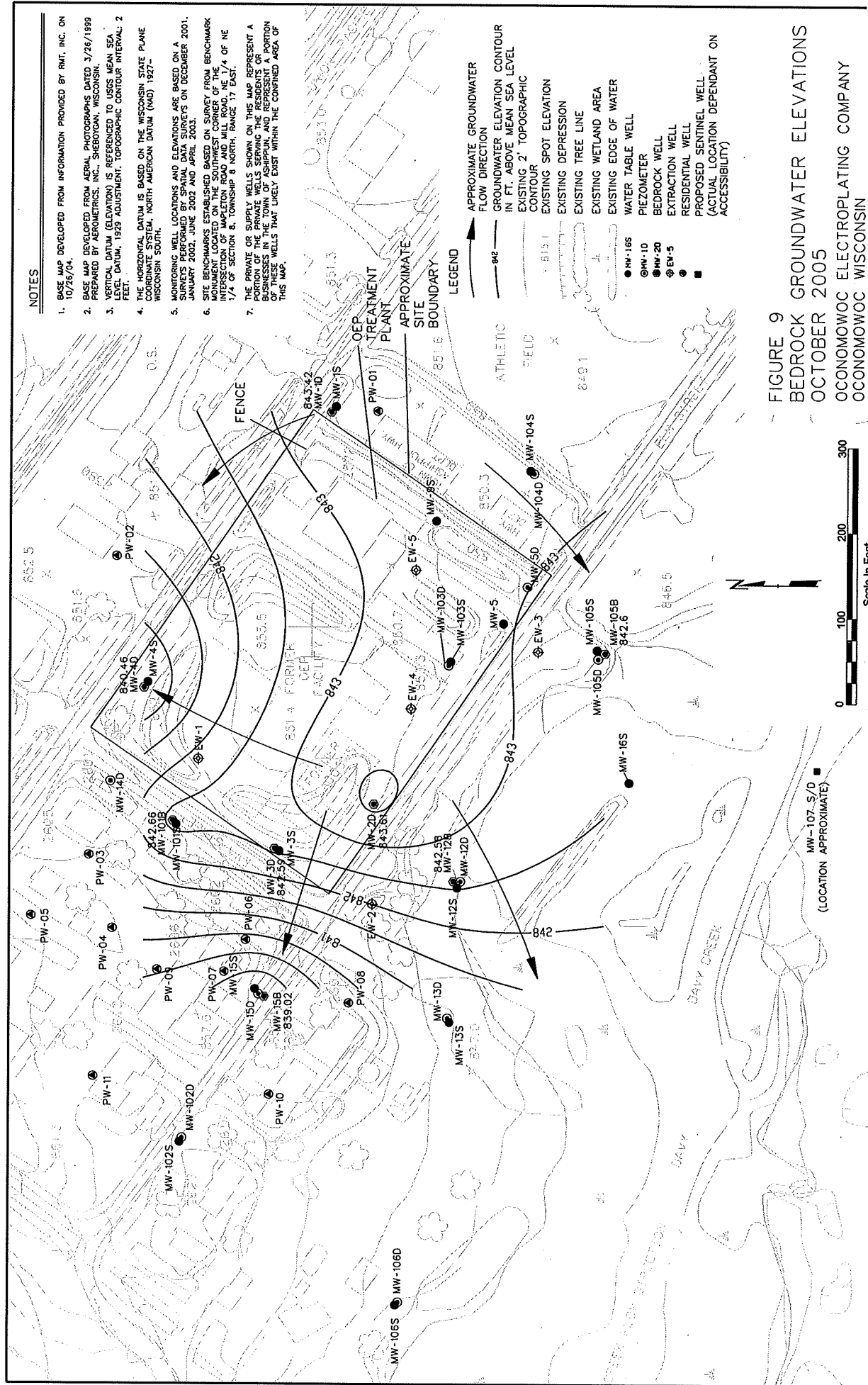
**FIGURE 7**  
**BEDROCK GROUNDWATER ELEVATIONS**  
**OCTOBER 2004**  
 OCONOMOWOC ELECTROPLATING COMPANY  
 OCONOMOWOC WISCONSIN





**NOTES**

1. BASE MAP DEVELOPED FROM INFORMATION PROVIDED BY RMT, INC. ON 10/26/04.
2. BASE MAP DEVELOPED FROM AERIAL PHOTOGRAPHS DATED 3/26/1999 PREPARED BY AEROMETRICS, INC., SHEBOYGAN, WISCONSIN.
3. VERTICAL DATUM (ELEVATION) IS REFERENCED TO USGS MEAN SEA LEVEL DATUM, 1929 ADJUSTMENT. TOPOGRAPHIC CONTOUR INTERVAL: 2 FEET.
4. THE HORIZONTAL DATUM IS BASED ON THE WISCONSIN STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1983 - WISCONSIN SOUTH.
5. MONITORING WELL LOCATIONS AND ELEVATIONS ARE BASED ON A SURVEY PERFORMED BY SPATIAL DATA SURVEYS ON DECEMBER 2001, JANUARY 2002, JUNE 2002 AND APRIL 2003.
6. SITE BENCHMARKS ESTABLISHED BASED ON SURVEY FROM BENCHMARK MONUMENT LOCATED ON THE SOUTHWEST CORNER OF THE INTERSECTION OF MAPLETON ROAD AND MILL ROAD, NE 1/4 OF NE 1/4 OF SECTION 6, TOWNSHIP 8 NORTH, RANGE 17 EAST.
7. THE PRIVATE OR SUPPLY WELLS SHOWN ON THIS MAP REPRESENT A PORTION OF THE PRIVATE WELLS SERVING THE RESIDENTS OR BUSINESS OF THE AREA. THE LOCATION OF THESE WELLS IS APPROXIMATE AND THESE WELLS THAT LIE EAST WITHIN THE CONFINED AREA OF THIS MAP.

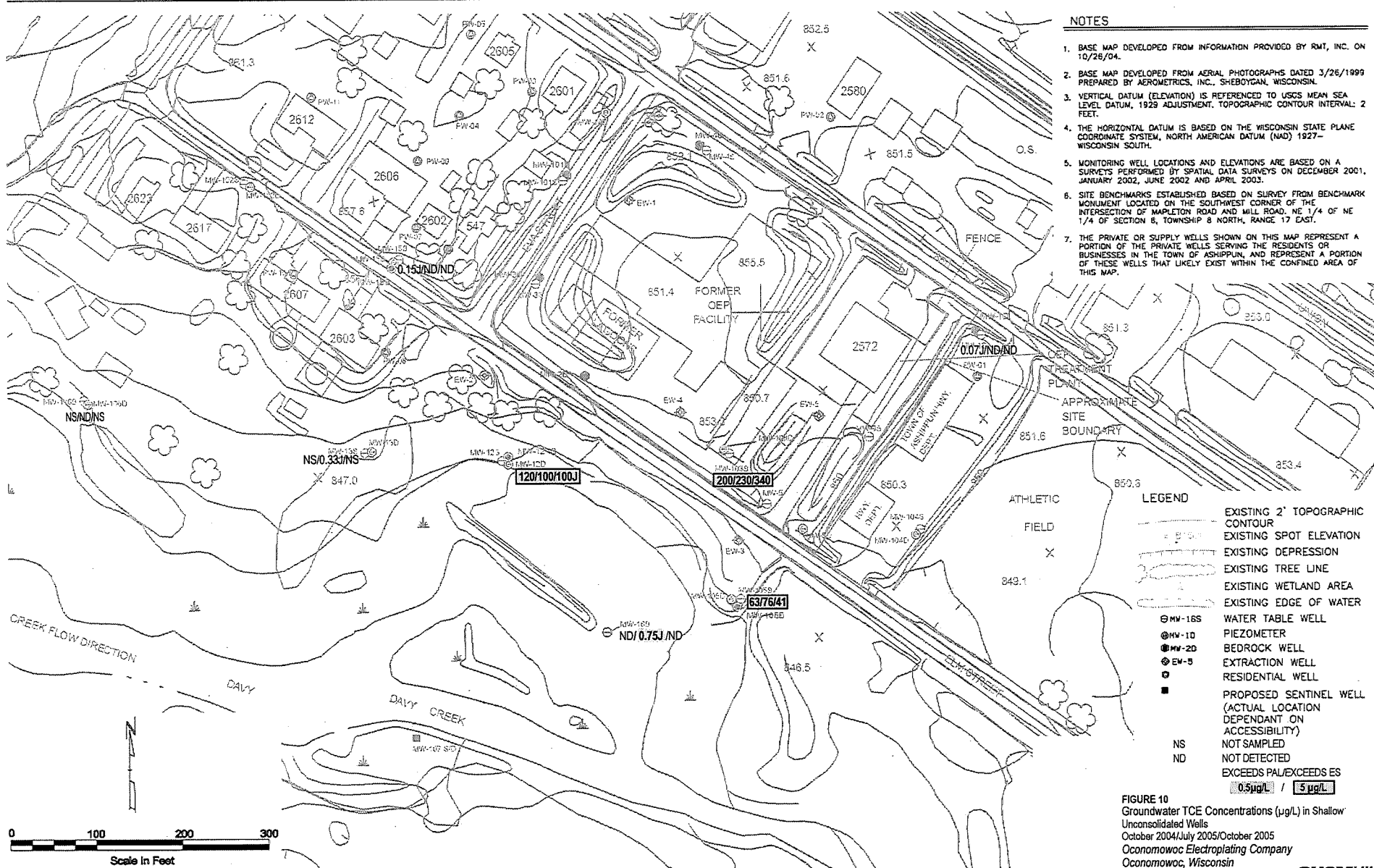


**FIGURE 9**  
**GROUNDWATER ELEVATIONS**  
**BEDROCK**  
**OCTOBER 2005**  
**OCONOMOWOC ELECTROPLATING COMPANY**  
**OCONOMOWOC WISCONSIN**

Scale In Feet  
 0 100 200 300

15-FEB-2006 08:23:14





**NOTES**

1. BASE MAP DEVELOPED FROM INFORMATION PROVIDED BY RMT, INC. ON 10/26/04.
2. BASE MAP DEVELOPED FROM AERIAL PHOTOGRAPHS DATED 3/26/1999 PREPARED BY AEROMETRICS, INC., SHEBOYGAN, WISCONSIN.
3. VERTICAL DATUM (ELEVATION) IS REFERENCED TO USGS MEAN SEA LEVEL DATUM, 1929 ADJUSTMENT. TOPOGRAPHIC CONTOUR INTERVAL: 2 FEET.
4. THE HORIZONTAL DATUM IS BASED ON THE WISCONSIN STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927—WISCONSIN SOUTH.
5. MONITORING WELL LOCATIONS AND ELEVATIONS ARE BASED ON A SURVEYS PERFORMED BY SPATIAL DATA SURVEYS ON DECEMBER 2001, JANUARY 2002, JUNE 2002 AND APRIL 2003.
6. SITE BENCHMARKS ESTABLISHED BASED ON SURVEY FROM BENCHMARK MONUMENT LOCATED ON THE SOUTHWEST CORNER OF THE INTERSECTION OF MAPLETON ROAD AND MILL ROAD, NE 1/4 OF NE 1/4 OF SECTION 8, TOWNSHIP 8 NORTH, RANGE 17 EAST.
7. THE PRIVATE OR SUPPLY WELLS SHOWN ON THIS MAP REPRESENT A PORTION OF THE PRIVATE WELLS SERVING THE RESIDENTS OR BUSINESSES IN THE TOWN OF ASHPIPPUN, AND REPRESENT A PORTION OF THESE WELLS THAT LIKELY EXIST WITHIN THE CONFINED AREA OF THIS MAP.

**LEGEND**

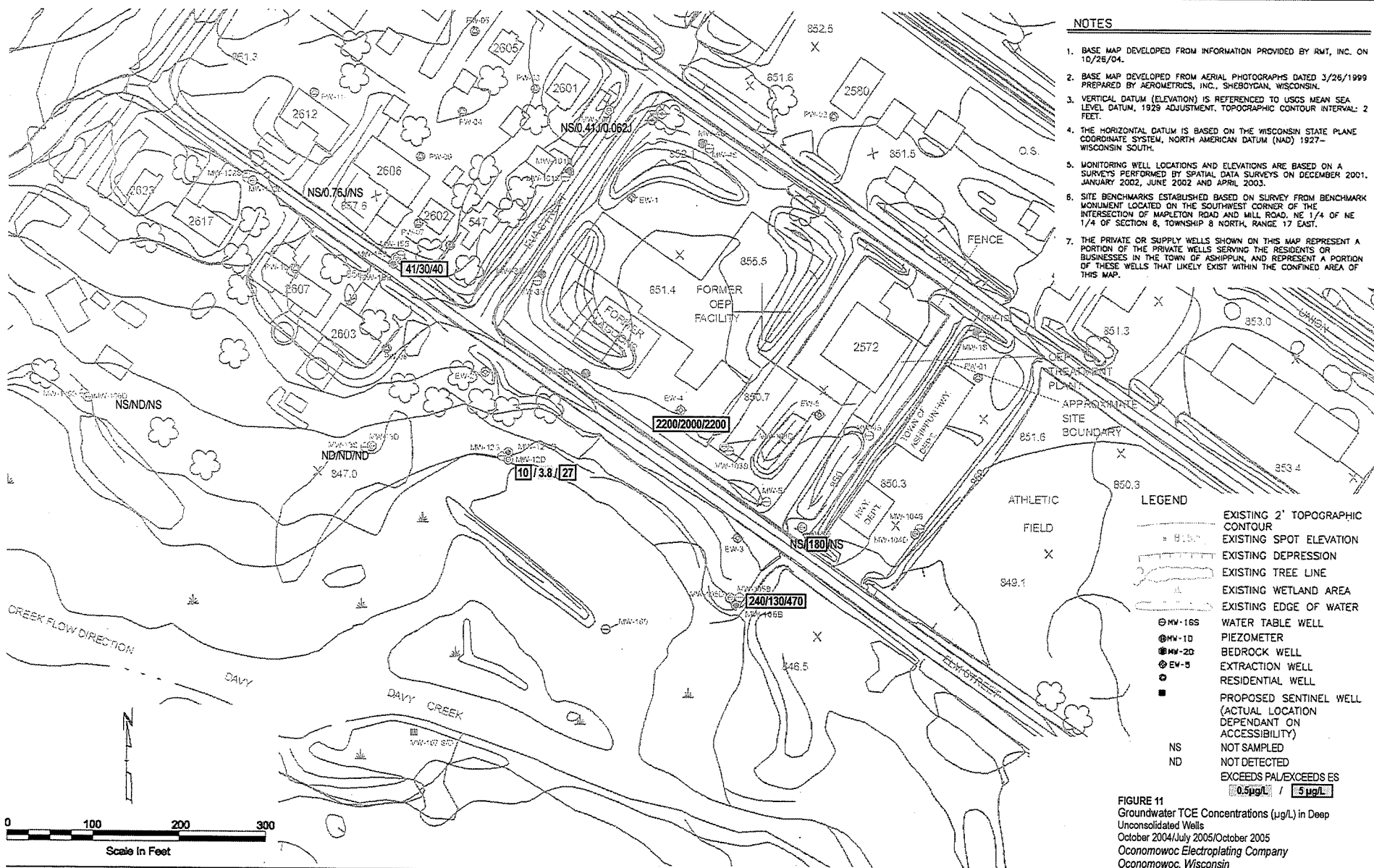
- EXISTING 2' TOPOGRAPHIC CONTOUR
- EXISTING SPOT ELEVATION
- - - EXISTING DEPRESSION
- EXISTING TREE LINE
- EXISTING WETLAND AREA
- EXISTING EDGE OF WATER
- MW-18S WATER TABLE WELL
- MW-10 PIEZOMETER
- MW-20 BEDROCK WELL
- EW-5 EXTRACTION WELL
- RESIDENTIAL WELL
- PROPOSED SENTINEL WELL (ACTUAL LOCATION DEPENDANT ON ACCESSIBILITY)
- NS NOT SAMPLED
- ND NOT DETECTED
- 0.5 µg/L / 5 µg/L EXCEEDS PAL/EXCEEDS ES

**FIGURE 10**  
 Groundwater TCE Concentrations (µg/L) in Shallow Unconsolidated Wells  
 October 2004/July 2005/October 2005  
 Oconomowoc Electroplating Company  
 Oconomowoc, Wisconsin

**CH2MHILL**



ES02200607/NE Figure 10, v2.dwg 2-14-06.caw



**NOTES**

1. BASE MAP DEVELOPED FROM INFORMATION PROVIDED BY RMT, INC. ON 10/28/04.
2. BASE MAP DEVELOPED FROM AERIAL PHOTOGRAPHS DATED 3/25/1999 PREPARED BY AEROMETRICS, INC., SHEBOYGAN, WISCONSIN.
3. VERTICAL DATUM (ELEVATION) IS REFERENCED TO USCS MEAN SEA LEVEL DATUM, 1929 ADJUSTMENT. TOPOGRAPHIC CONTOUR INTERVAL: 2 FEET.
4. THE HORIZONTAL DATUM IS BASED ON THE WISCONSIN STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927 - WISCONSIN SOUTH.
5. MONITORING WELL LOCATIONS AND ELEVATIONS ARE BASED ON A SURVEYS PERFORMED BY SPATIAL DATA SURVEYS ON DECEMBER 2001, JANUARY 2002, JUNE 2002 AND APRIL 2003.
6. SITE BENCHMARKS ESTABLISHED BASED ON SURVEY FROM BENCHMARK MONUMENT LOCATED ON THE SOUTHWEST CORNER OF THE INTERSECTION OF MAPLETON ROAD AND MILL ROAD, NE 1/4 OF NE 1/4 OF SECTION 8, TOWNSHIP 8 NORTH, RANGE 17 EAST.
7. THE PRIVATE OR SUPPLY WELLS SHOWN ON THIS MAP REPRESENT A PORTION OF THE PRIVATE WELLS SERVING THE RESIDENTS OR BUSINESSES IN THE TOWN OF ASHUPPIA, AND REPRESENT A PORTION OF THESE WELLS THAT LIKELY EXIST WITHIN THE CONFINED AREA OF THIS MAP.

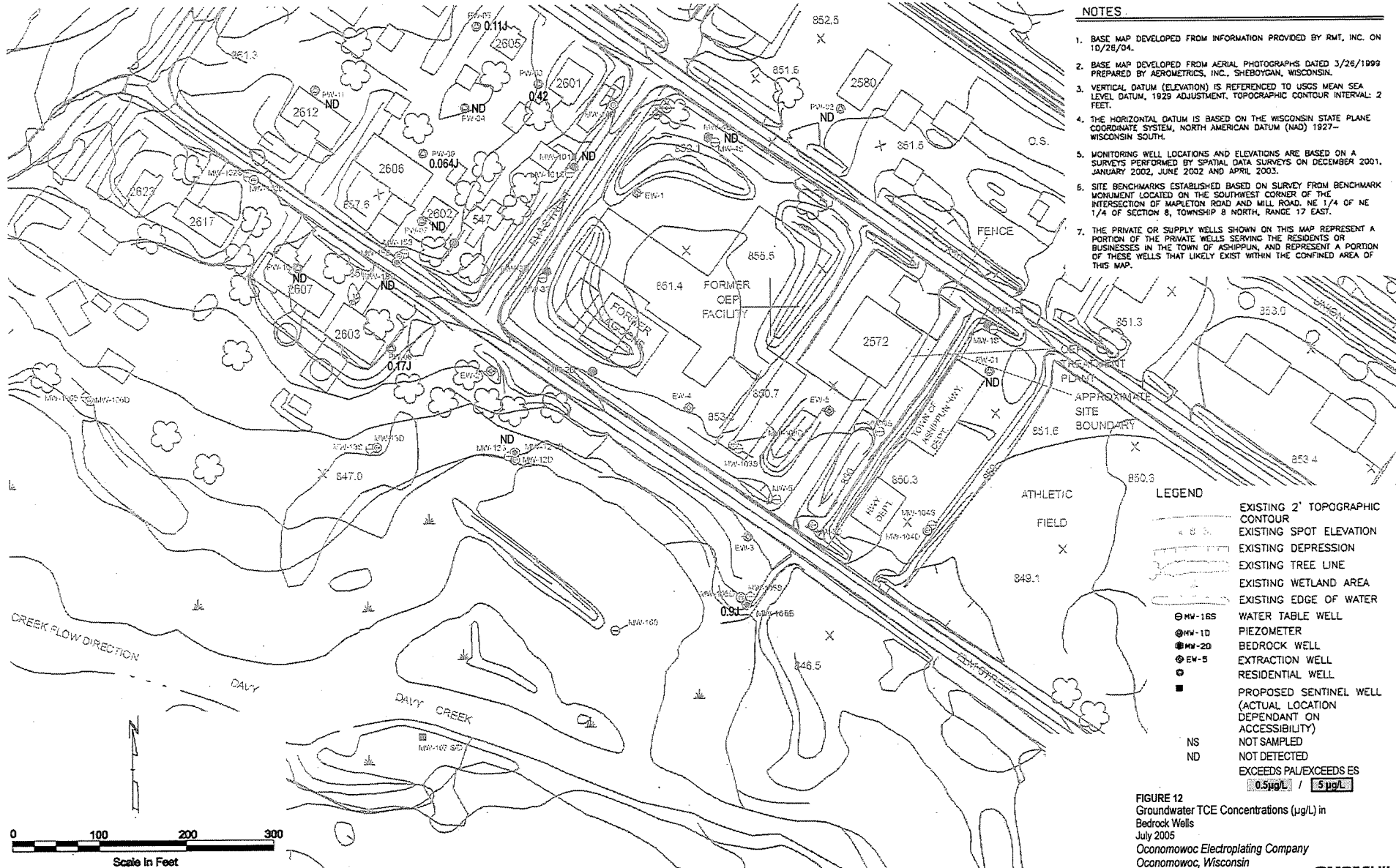
**LEGEND**

- - - - - EXISTING 2' TOPOGRAPHIC CONTOUR
- + 851.5 EXISTING SPOT ELEVATION
- - - - - EXISTING DEPRESSION
- - - - - EXISTING TREE LINE
- - - - - EXISTING WETLAND AREA
- - - - - EXISTING EDGE OF WATER
- ⊕ MW-165 WATER TABLE WELL
- ⊕ MW-10 PIEZOMETER
- ⊕ MW-20 BEDROCK WELL
- ⊕ EW-5 EXTRACTION WELL
- ⊕ RESIDENTIAL WELL
- PROPOSED SENTINEL WELL (ACTUAL LOCATION DEPENDANT ON ACCESSIBILITY)
- NS NOT SAMPLED
- ND NOT DETECTED
- EXCEEDS PAL/EXCEEDS ES  
0.5µg/L / 5 µg/L

**FIGURE 11**  
 Groundwater TCE Concentrations (µg/L) in Deep Unconsolidated Wells  
 October 2004/July 2005/October 2005  
 Oconomowoc Electroplating Company  
 Oconomowoc, Wisconsin



ES02200007AME Figure 11, 12/14/06.dwg



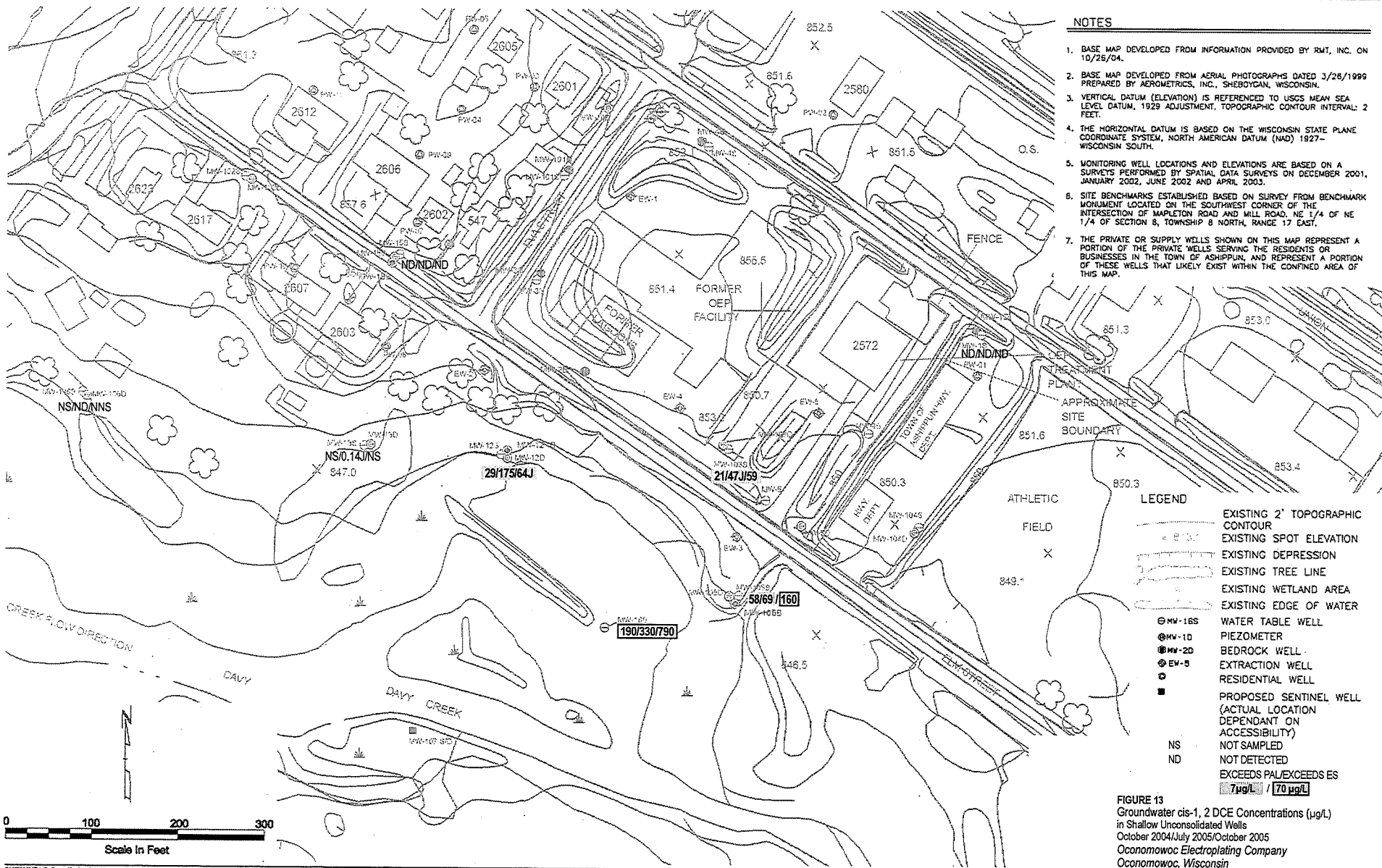
- NOTES**
1. BASE MAP DEVELOPED FROM INFORMATION PROVIDED BY RMT, INC. ON 10/28/04.
  2. BASE MAP DEVELOPED FROM AERIAL PHOTOGRAPHS DATED 3/26/1999 PREPARED BY AEROMETRICS, INC., SHEBOYGAN, WISCONSIN.
  3. VERTICAL DATUM (ELEVATION) IS REFERENCED TO USGS MEAN SEA LEVEL DATUM, 1929 ADJUSTMENT, TOPOGRAPHIC CONTOUR INTERVAL: 2 FEET.
  4. THE HORIZONTAL DATUM IS BASED ON THE WISCONSIN STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927-- WISCONSIN SOUTH.
  5. MONITORING WELL LOCATIONS AND ELEVATIONS ARE BASED ON A SURVEYS PERFORMED BY SPATIAL DATA SURVEYS ON DECEMBER 2001, JANUARY 2002, JUNE 2002 AND APRIL 2003.
  6. SITE BENCHMARKS ESTABLISHED BASED ON SURVEY FROM BENCHMARK MONUMENT LOCATED ON THE SOUTHWEST CORNER OF THE INTERSECTION OF MAPLETON ROAD AND MILL ROAD, NE 1/4 OF NE 1/4 OF SECTION 8, TOWNSHIP 8 NORTH, RANGE 17 EAST.
  7. THE PRIVATE OR SUPPLY WELLS SHOWN ON THIS MAP REPRESENT A PORTION OF THE PRIVATE WELLS SERVING THE RESIDENTS OR BUSINESSES IN THE TOWN OF ASHIPPIUN, AND REPRESENT A PORTION OF THESE WELLS THAT LIKELY EXIST WITHIN THE CONFIRMED AREA OF THIS MAP.

**LEGEND**

	EXISTING 2' TOPOGRAPHIC CONTOUR
	EXISTING SPOT ELEVATION
	EXISTING DEPRESSION
	EXISTING TREE LINE
	EXISTING WETLAND AREA
	EXISTING EDGE OF WATER
	WATER TABLE WELL
	PIEZOMETER
	BEDROCK WELL
	EXTRACTION WELL
	RESIDENTIAL WELL
	PROPOSED SENTINEL WELL (ACTUAL LOCATION DEPENDANT ON ACCESSIBILITY)
	NS NOT SAMPLED
	ND NOT DETECTED
	EXCEEDS PAL/EXCEEDS ES 0.5 µg/L / 5 µg/L

**FIGURE 12**  
Groundwater TCE Concentrations (µg/L) in Bedrock Wells  
July 2005  
Oconomowoc Electroplating Company  
Oconomowoc, Wisconsin

ES02200007MHC Figure 12.dwg 2-14-05.mxd



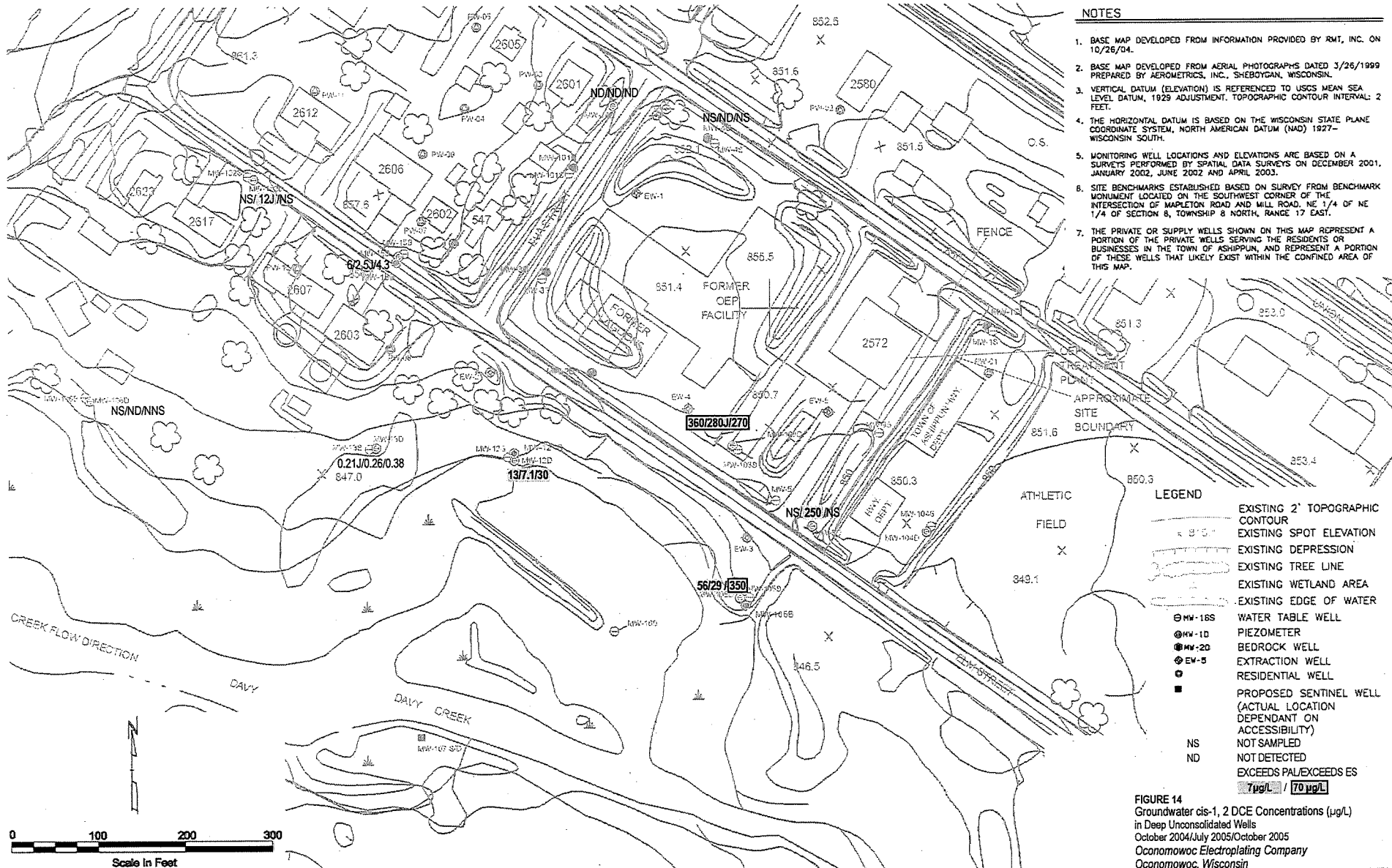
**NOTES**

1. BASE MAP DEVELOPED FROM INFORMATION PROVIDED BY RMT, INC. ON 10/26/04.
2. BASE MAP DEVELOPED FROM AERIAL PHOTOGRAPHS DATED 3/26/1999 PREPARED BY AEROMETRICS, INC., SHEBOYGAN, WISCONSIN.
3. VERTICAL DATUM (ELEVATION) IS REFERENCED TO USCS MEAN SEA LEVEL DATUM, 1929 ADJUSTMENT. TOPOGRAPHIC CONTOUR INTERVAL: 2 FEET.
4. THE HORIZONTAL DATUM IS BASED ON THE WISCONSIN STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927- WISCONSIN SOUTH.
5. MONITORING WELL LOCATIONS AND ELEVATIONS ARE BASED ON A SURVEYS PERFORMED BY SPATIAL DATA SURVEYS ON DECEMBER 2001, JANUARY 2002, JUNE 2002 AND APRIL 2003.
6. SITE BENCHMARKS ESTABLISHED BASED ON SURVEY FROM BENCHMARK MONUMENT LOCATED ON THE SOUTHWEST CORNER OF THE INTERSECTION OF MAPLETON ROAD AND MILL ROAD, NE 1/4 OF NE 1/4 OF SECTION 8, TOWNSHIP 8 NORTH, RANGE 17 EAST.
7. THE PRIVATE OR SUPPLY WELLS SHOWN ON THIS MAP REPRESENT A PORTION OF THE PRIVATE WELLS SERVING THE RESIDENTS OR BUSINESSES IN THE TOWN OF ASHPUN, AND REPRESENT A PORTION OF THESE WELLS THAT LIKELY EXIST WITHIN THE CONFINED AREA OF THIS MAP.

**LEGEND**

- EXISTING 2' TOPOGRAPHIC CONTOUR
- EXISTING SPOT ELEVATION
- EXISTING DEPRESSION
- EXISTING TREE LINE
- EXISTING WETLAND AREA
- EXISTING EDGE OF WATER
- MW-16S WATER TABLE WELL
- MW-10 PIEZOMETER
- MW-20 BEDROCK WELL
- EV-5 EXTRACTION WELL
- RESIDENTIAL WELL
- PROPOSED SENTINEL WELL (ACTUAL LOCATION DEPENDANT ON ACCESSIBILITY)
- NS NOT SAMPLED
- ND NOT DETECTED
- EXCEEDS PAL/EXCEEDS ES (7µg/L) / (70 µg/L)

FIGURE 13  
Groundwater cis-1, 2 DCE Concentrations (µg/L)  
in Shallow Unconsolidated Wells  
October 2004/July 2005/October 2005  
Oconomowoc Electroplating Company  
Oconomowoc, Wisconsin



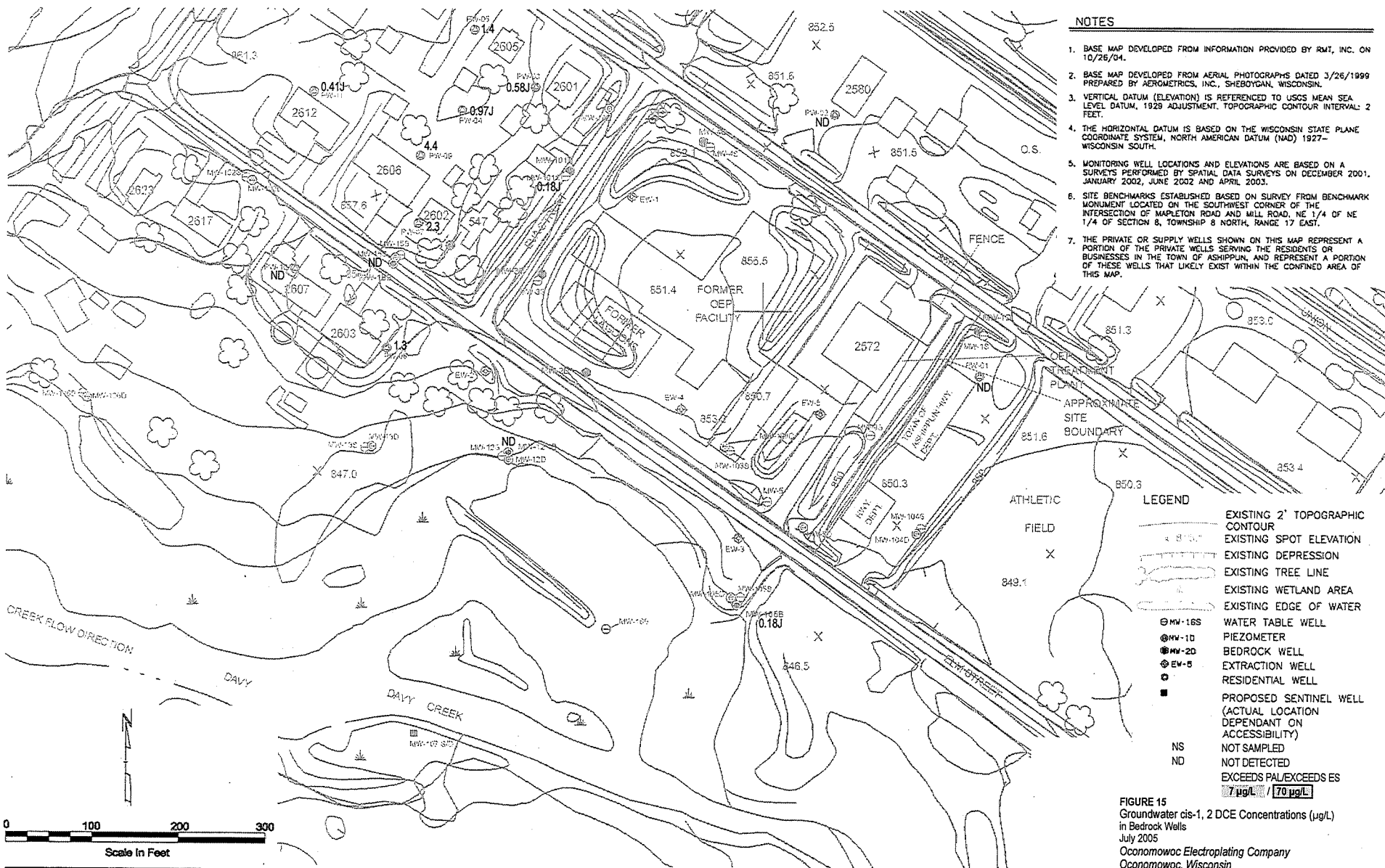
- NOTES**
1. BASE MAP DEVELOPED FROM INFORMATION PROVIDED BY RMT, INC. ON 10/26/04.
  2. BASE MAP DEVELOPED FROM AERIAL PHOTOGRAPHS DATED 3/26/1999 PREPARED BY AEROMETRICS, INC., SHEBOYGAN, WISCONSIN.
  3. VERTICAL DATUM (ELEVATION) IS REFERENCED TO USCS MEAN SEA LEVEL DATUM, 1929 ADJUSTMENT. TOPOGRAPHIC CONTOUR INTERVAL: 2 FEET.
  4. THE HORIZONTAL DATUM IS BASED ON THE WISCONSIN STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927-- WISCONSIN SOUTH.
  5. MONITORING WELL LOCATIONS AND ELEVATIONS ARE BASED ON A SURVEYS PERFORMED BY SPATIAL DATA SURVEYS ON DECEMBER 2001, JANUARY 2002, JUNE 2002 AND APRIL 2003.
  6. SITE BENCHMARKS ESTABLISHED BASED ON SURVEY FROM BENCHMARK MONUMENT LOCATED ON THE SOUTHWEST CORNER OF THE INTERSECTION OF MAPLETON ROAD AND MILL ROAD, NE 1/4 OF NE 1/4 OF SECTION 8, TOWNSHIP 8 NORTH, RANGE 17 EAST.
  7. THE PRIVATE OR SUPPLY WELLS SHOWN ON THIS MAP REPRESENT A PORTION OF THE PRIVATE WELLS SERVING THE RESIDENTS OR BUSINESSES IN THE TOWN OF ASHPIPP, AND REPRESENT A PORTION OF THESE WELLS THAT LIKELY EXIST WITHIN THE CONFINED AREA OF THIS MAP.

**LEGEND**

	EXISTING 2' TOPOGRAPHIC CONTOUR
	EXISTING SPOT ELEVATION
	EXISTING DEPRESSION
	EXISTING TREE LINE
	EXISTING WETLAND AREA
	EXISTING EDGE OF WATER
	WATER TABLE WELL
	PIEZOMETER
	BEDROCK WELL
	EXTRACTION WELL
	RESIDENTIAL WELL
	PROPOSED SENTINEL WELL (ACTUAL LOCATION DEPENDANT ON ACCESSIBILITY)
NS	NOT SAMPLED
ND	NOT DETECTED
	EXCEEDS PAL/EXCEEDS ES
	70 µg/L / 70 µg/L

**FIGURE 14**  
 Groundwater cis-1, 2 DCE Concentrations (µg/L)  
 in Deep Unconsolidated Wells  
 October 2004/July 2005/October 2005  
 Oconomowoc Electroplating Company  
 Oconomowoc, Wisconsin

ES02200607MNE Figure 14\_02a 2-14-06.csw





**Appendix A**  
**Data Validation Memorandums**

---

## Data Quality Evaluation Oconomowoc Electroplating – SDG 43523

PREPARED FOR: Jeff Danko/CH2M HILL  
PREPARED BY: Steven Paukner/CH2M HILL  
COPIES: Heather Hodach/CH2M HILL  
Cindi Cruciani/CH2M HILL  
DATE: February 13, 2006

This memorandum presents the data quality evaluation for the groundwater sampling event conducted at the Oconomowoc Electroplating during the week of October 10, 2004. The analyses were performed by CT Laboratories, Inc. (CTL), of Baraboo, Wisconsin.

The samples were collected and analyzed for one or more of the following:

- Volatile organic compounds (VOCs) by SW-846 8260
- Dissolved gases by modified RSK-175
- Total metals by SW-846 6010
- Dissolved metals by SW-846 6010
- Total Organic Carbon by SW-846 9060
- Select general chemistry parameters by SW-846 9056 (anions), EPA 310.2 (alkalinity) and EPA 376.1 (sulfide)

The data were reviewed to assess their analytical accuracy, precision, and completeness. The review was conducted in accordance with the site-specific *Quality Assurance Project Plan* (QAPP) (CH2M HILL, 2002b), and the Special Analytical Services (SASs) forms. A forms review was conducted on 100 percent of the definitive data collected. The forms review consisted of a review of the following quality control (QC) items in accordance with the U.S. Environmental Protection Agency (USEPA) *Functional Guidelines for Laboratory Data Review* (USEPA, 1999 and 2004) and the site-specific QAPP:

- Holding times and sample temperature
- Instrument tuning criteria (where applicable)
- Initial calibration and continuing calibration
- Laboratory control sample (LCS) Surrogate recovery
- Blank contamination
- Matrix spike/matrix spike duplicate (MS/MSD)
- Field duplicate precision The QA/QC limits implemented during the data quality evaluation were those listed in the site-specific QAPP, SASs, and the USEPA *National Functional Guidelines for Laboratory Data Review* (USEPA, 1999 and 2004).

Standard data qualifiers were added as a means of classifying the data as to their conformance to QA/QC requirements. The data qualifiers are defined as follows:

- [=] Detected. The analyte was analyzed for and detected at the concentration level shown.
- [U] Undetected. The analyte was analyzed for but not detected at a concentration equal to or greater than the laboratory reporting limit.
- [J] Estimated. The analyte was below the stated reporting limit (RL), but greater than the method detection limit (MDL), or there is an analytical bias.
- [UJ] The analyte was analyzed for, but not detected at a level equal to or greater than the reporting limit. This flag was used when the QA/QC data indicated a bias in the analytical result. The reporting limit should be considered an estimated value.
- [UB] Undetected due to blank contamination. The analyte was detected in the sample and in an associated method, field, or trip blank. The quantity of the analyte is deemed undetected because it falls below the 95 percent confidence interval (five times the blank concentration). The reported analyte concentration is potentially affected by artifacts from the laboratory or field operations.

The sections below are designed to summarize data quality issues. If no QC issues are included below, the QAPP objectives were met.

## VOCs by SW-846 8260 and Dissolved Gases by RSK-175

### Initial Calibration

The initial calibration verification (ICV) analyzed along with field samples contained relative response factor (RRF) values for acetone and 2-butanone that exceeded the QC limit of 0.05. Detected concentrations of these analytes within the field samples were qualified and flagged "J" as estimated in quantity. Nondetected sample results were qualified and flagged "UJ" as undetected and estimated in quantity. The following samples and corresponding analytes were qualified and flagged:

- OEP-MW-012D, OEP-MW-012S, OEP-MW-013D, OEP-MW-016S, OEP-MW-105D, OEP-MW-014D, OEP-MW-105S, OEP-MW-103D, OEP-MW-103S, OEP-MW-015D, OEP-MW-015S, OEP-MW-001S, OEP-MW-001SFR
  - acetone (UJ), 2-butanone (UJ)

### Laboratory Control Samples

The laboratory control sample (LCS) associated with this SDG exhibited a percent recovery (%R) for methylene chloride of 44 percent, which was below the SAS specified QC limit of 60 percent. Detected concentrations of methylene chloride within the field samples were qualified and flagged "J" as estimated in quantity. Nondetected sample results were qualified and flagged "UJ" as undetected and estimated in quantity. The following samples and corresponding analytes were qualified and flagged:

- OEP-MW-012D, OEP-MW-012S, OEP-MW-013D, OEP-MW-016S, OEP-MW-105D, OEP-MW-014D, OEP-MW-105S, OEP-MW-103D, OEP-MW-103S, OEP-MW-015D, OEP-MW-015S, OEP-MW-001S, OEP-MW-001SFR
  - Methylene chloride (U)

## Blanks

The field blank associated with this SDG contained estimated concentrations of benzene and chloroform of 0.092 µg/L and 0.49 µg/L, respectively. The detectable concentration of benzene and chloroform within the following samples did not exceed the 95 percent confidence interval of 0.46 µg/L and 2.45 µg/L; therefore, benzene and chloroform were qualified and flagged "UB" as undetected due to blank contamination:

- OEP-MW-012D, OEP-MW-10S, OEP-MW-015D
  - Benzene (UB)
- OEP-MW-012S, OEP-MW-103D, OEP-MW-103S
  - Benzene (UB), chloroform (UB)

## Metals by SW-846 6010

### ICP Serial Dilution

The percent difference between the original analysis and the serial dilution analysis for total iron was found to be 15 percent, which is greater than the 10 percent QC criterion. Since the analyte concentration of 448 µg/L was > 50 times the instrument detection limit (IDL) of 6 µg/L, the total iron result in sample OEP-MW-015S was qualified and flagged "J" as estimated in quantity.

### Sample Evaluation

Sample OEP-MW-105D contained a dissolved iron concentration of 863 µg/L, which was greater than the total iron concentration of 845 µg/L. It is expected that total metal concentrations would be greater than dissolved metal concentrations due to the amount of suspended particulates (i.e. metals) in a water sample. This causes abnormal results and therefore, both total and dissolved iron in sample OEP-MW-105D were qualified and flagged "J" as estimated in quantity due to possible sampling error in the field.

### Field Duplicates

The field duplicate OEP-MW-001SFR within this SDG exhibited a RPD for total iron of 53 percent, which exceeded the QC limit of 20 percent for aqueous samples; therefore, total iron in the native sample OEP-MW-001S was qualified and flagged "J" as estimated due to poor accuracy.

## General Chemistry by EPA 310.2, EPA 376.1, SW-846 9056 and SW-846 9060

### Holding Times

Samples collected on October 24<sup>th</sup>, 2004 were analyzed for nitrate outside of recommended 48-hour hold-time. Detected nitrate concentrations within the field samples were qualified and flagged "J" as estimated in quantity. Nondetected sample results were qualified and flagged "UJ" as undetected and estimated in quantity. The following samples and corresponding analytes were qualified and flagged:

- OEP-MW-014D, OEP-MW-103S, OEP-MW-105D, OEP-MW-015S, OEP-MW-001S  
– Nitrate (J)
- OEP-MW-105D, OEP-MW-105S, OEP-MW-103D  
– Nitrate (UJ)

### Spiked Sample

The spiked sample associated with sample OEP-MW-016S contained a %R for sulfate of 65 percent, which fell below the lower QC limit of 80 percent. Detected concentrations were qualified and flagged "J" as estimated in quantity. Nondetected sample results were qualified and flagged "UJ" as undetected and estimated in quantity. Therefore, sulfate in sample OEP-MW-016S was qualified and flagged "J" as estimated in quantity.

### Laboratory Control Sample

The LCS/LCSD associated with this SDG exhibited a percent recovery (%R) for sulfide at 64 percent and 60 percent, respectively. These were below the SAS specified QC limit of 80 percent. Detected sulfide concentrations within the field samples were qualified and flagged "J" as estimated in quantity. Nondetected sample results were qualified and flagged "UJ" as undetected and estimated in quantity. The following samples and corresponding analytes were qualified and flagged:

- OEP-MW-012D, OEP-MW-012S, OEP-MW-013D, OEP-MW-016S, OEP-MW-105D, OEP-MW-014D, OEP-MW-105S, OEP-MW-103D, OEP-MW-103S, OEP-MW-015D, OEP-MW-015S, OEP-MW-001S, OEP-MW-001SFR  
– Sulfide (UJ)

### Conclusions

The quality assurance project plan (QAPP) for the Oconomowoc Electroplating site states a completeness goal of 90%. Completeness as defined by the QAPP is the percent of valid data obtained compared to the total amount of data obtained. Therefore, as defined by the QAPP, all of the data reviewed by the USEPA is considered valid data and the completeness goal of 90% was achieved. The sample data may be used to make project decisions as qualified by the laboratory and herein.

## References

CH2M HILL. 2004. *Quality Assurance Project Plan – Oconomowoc Electroplating*. October.

USEPA. 1994. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. February.

USEPA. 1999. *Contract Laboratory Program National Functional Guidelines for Organic Data Review*. October.

## Oconomowoc Electroplating - Data Review SDG 48108

PREPARED FOR: Jeff Danko/CH2M HILL  
PREPARED BY: Heather Hodach, Steve Paukner/CH2M HILL  
DATE: November 8, 2005

This memorandum presents a review of the results within Sample Delivery Group (SDG) 48108 from the Oconomowoc Electroplating sampling event conducted July 11-14, 2005. Compliance and Natural Attenuation (NA) samples were collected, analyzed, and validated. All of the samples were analyzed by CT Laboratories of Baraboo, Wisconsin. The NA data were reviewed by CH2M HILL and the Compliance data were reviewed by a USEPA contractor (see Attachment A1) to assess its' accuracy, precision, and completeness using the criteria established in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (October 1999) and *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (July 2002). Data quality control (QC) summary forms and data reports were reviewed. Data qualifiers were added when the QC data indicated a bias. These changes and comments are noted below.

Standard data qualifiers were used as a means of classifying the data as to their conformance to QC requirements. The data qualifiers are defined as follows:

- [U] The component was analyzed for but not detected at a level equal to or greater than the reporting limit. This flag was used when the QC data indicated a bias in the analytical data but the direction of bias was unknown.
- [E] Estimated. Used when the data indicated the presence of a component was below the stated reporting limit or when the direction of analytical bias was unknown.
- [R] Rejected. The data is of insufficient quality to be deemed acceptable as reported or otherwise qualified. The analytical data was reviewed against the following QA/QC parameters:
- Completeness (were all the samples analyzed for the requested analytical parameters)
  - Holding times prior to extraction and analysis
  - Continuing calibration precision and accuracy
  - Blank results
  - Laboratory control sample (LCS) precision and accuracy
  - Matrix spike/matrix spike duplicate (MS/MSD) precision and accuracy
  - Field duplicate precision
  - Overall assessment of data

The QA/QC parameters were within acceptable control limits except where noted below.

### Volatiles

The initial calibration report associated within this SDG contained relative response factors (RRFs) lower than 0.05 for acetone, 2-Butanone and 1,2-dibromo-3-chloropropane. Detected

concentrations in samples associated with this continuing calibration report were qualified and flagged "J" while non-detected concentrations were qualified and flagged "R" as rejected. The following samples and corresponding analytes were qualified and flagged:

- 05CA40-08, 05CA40-16, 05CA40-24, 05CA40-26
  - Acetone (R)
  - 2-Butanone (R)
  - 1,2-dibromo-3-chloropropane (R)

The continuing calibration report associated with analytical run number 31245 within this SDG demonstrated percent differences (%D) below the QC limit of  $\pm 25\%$  for bromomethane, methylene chloride, 1,2,4-trichlorobenzene, chloromethane and dichlorodifluoromethane. Detected concentrations in samples associated with this continuing calibration report were qualified and flagged "J" while non-detected concentrations were qualified and flagged "UJ" as estimated in quantity. The following samples and corresponding analytes were qualified and flagged:

- 05CA40-08, 05CA40-16
  - bromomethane (UJ)
  - methylene chloride (UJ)
  - 1,2,4-trichlorobenzene (UJ)
  - chloromethane (UJ)
  - dichlorodifluoromethane (UJ)

The continuing calibration report associated with analytical run number 31293 within this SDG demonstrated percent differences (%D) below the QC limit of  $\pm 25\%$  for bromomethane, methylene chloride, bromoform, 1,2,4-trichlorobenzene, 1,2,3-trichlorobenzene and dichlorodifluoromethane. Detected concentrations in samples associated with this continuing calibration report were qualified and flagged "J" while non-detected concentrations were qualified and flagged "UJ" as estimated in quantity. The following samples and corresponding analytes were qualified and flagged:

- 05CA40-24, 05CA40-26
  - bromomethane (UJ)
  - methylene chloride (UJ)
  - bromoform (UJ)
  - 1,2,4-trichlorobenzene (UJ)
  - 1,2,3-dichlorobenzene (UJ)
  - dichlorodifluoromethane (UJ)

#### **Total and Dissolved Metals**

The laboratory duplicate for samples 05CA40-02 and 05CA40-16 demonstrated relative percent differences (%RPD) for total iron of 37% and 60% respectively, which were outside the QC criteria of  $\pm 20\%$ . Detected concentrations of total iron in these samples were qualified and flagged "J" while non-detected concentrations were qualified and flagged "UJ" as estimated in quantity. The following samples and corresponding analytes were qualified and flagged:

- 05CA40-02
  - total iron (UJ)



- 05CA40-16
  - total iron (J)

Field duplicate 05CA40-28, exhibited a RPD for total iron of 87.2% when compared to native sample 05CA40-26, which exceeded the QC limit of 30% for aqueous samples. The detected concentrations of the affected analytes in both the native and duplicate samples were qualified and flagged "J" as detected and estimated in quantity. Non detected concentrations were qualified and flagged "UJ". The following samples and corresponding analytes were qualified and flagged:

- 05CA40-26, 05CA40-28
  - total iron (J)

### **General Chemistry**

All QC data were within applicable limits, therefore no further corrective action was deemed necessary or taken.

### **Conclusion**

The rejection of the acetone, 2-Butanone and 1,2-dibromo-3-chloropropane in 4 samples was due to extremely low response factors. A response factor of less than 0.05 indicates poor response of a compound on the instrument and therefore, the laboratory cannot, with confidence, report that the related compounds are not present in the sample. Therefore, nondetect results were rejected and must be considered "unusable" by the data user.

Overall, the analytical results are acceptable as reported unless otherwise qualified herein. Therefore the validated analytical results can be used to make project decisions.

## Oconomowoc Electroplating - Data Review SDG 49958

PREPARED FOR: Jeff Danko/CH2M HILL  
PREPARED BY: Heather Hodach  
DATE: November 28, 2005

This memorandum presents a review of the results within Sample Delivery Group (SDG) 49958 from the Oconomowoc Electroplating sampling event conducted October 3-5, 2005. Natural Attenuation (NA) samples were collected, analyzed, and validated. All of the samples were analyzed by CT Laboratories of Baraboo, Wisconsin. The NA data were reviewed by CH2M HILL to assess its' accuracy, precision, and completeness using the criteria established in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (October 1999) and *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (July 2002). Data quality control (QC) summary forms and data reports were reviewed. Data qualifiers were added when the QC data indicated a bias. These changes and comments are noted below.

Standard data qualifiers were used as a means of classifying the data as to their conformance to QC requirements. The data qualifiers are defined as follows:

- [U] The component was analyzed for but not detected at a level equal to or greater than the reporting limit. This flag was used when the QC data indicated a bias in the analytical data but the direction of bias was unknown.
- [E] Estimated. Used when the data indicated the presence of a component was below the stated reporting limit or when the direction of analytical bias was unknown.
- [UB] Not detected due to blank contamination. Used when the concentration of an analyte in the sample does not meet or exceed a 95% confidence interval as compared to the blank contamination.

The analytical data was reviewed against the following QA/QC parameters:

- Completeness (were all the samples analyzed for the requested analytical parameters)
- Holding times prior to extraction and analysis
- Continuing calibration precision and accuracy
- Blank results
- Laboratory control sample (LCS) precision and accuracy
- Matrix spike/matrix spike duplicate (MS/MSD) precision and accuracy
- Field duplicate precision
- Overall assessment of data

The QA/QC parameters were within acceptable control limits except where noted below.

### Volatiles

The initial calibration report associated within this SDG contained relative response factors (RRFs) lower than 0.05 for acetone, 2-Butanone and 1,2-dibromo-3-chloropropane. Detected concentrations in samples associated with this continuing calibration report were qualified and flagged "J" while non-detected concentrations were qualified and flagged "UJ" as estimated in quantity. The following samples and corresponding analytes were qualified and flagged:

- 06CA01-01, 06CA01-03, 06CA01-05, 06CA01-07, 06CA01-13, 06CA01-15, 06CA01-17, 06CA01-19, 06CA01-26, 06CA01-28, 06CA01-34
  - Acetone (UJ)
  - 2-Butanone (UJ)
  - 1,2-dibromo-3-chloropropane (UJ)
- 06CA01-09, 06CA01-32
  - Acetone (J)
  - 2-Butanone (UJ)
  - 1,2-dibromo-3-chloropropane (UJ)

The three continuing calibration verification reports associated with this SDG demonstrated percent differences (%D) outside the QC limit of  $\pm 25\%$  for methylene chloride. Detected concentrations in samples associated with this continuing calibration report were qualified and flagged "J" while non-detected concentrations were qualified and flagged "UJ" as estimated in quantity. The following samples and corresponding analytes were qualified and flagged:

- 06CA01-01, 06CA01-03, 06CA01-05, 06CA01-07, 06CA01-09, 06CA01-13, 06CA01-15, 06CA01-17, 06CA01-19, 06CA01-26, 06CA01-28, 06CA01-32, 06CA01-34
  - methylene chloride (J)

The laboratory control sample (LCS) associated with this SDG exhibited percent recoveries (%R) for methylene chloride and methyl tert-butyl ether of 216% and 151%, respectively, which were above the upper QC limit of 60%-130%. Detected concentrations not previously qualified were qualified and flagged "J" as detected and estimated in quantity. Non-detected concentrations were not qualified. The following samples were qualified and flagged:

- 06CA01-13, 06CA01-15, 06CA21-26, 06CA01-32, 06CA01-34
  - methyl tert-butyl ether (J)

Field duplicate 06CA01-15, exhibited a relative percent difference (RPD) 48.3% for methane, when compared to native sample 06CA01-13. This duplicate RPD exceeded the QC limit of 30% for aqueous samples. The detected concentrations of the affected analytes in both the native and duplicate samples were qualified and flagged "J" as detected and estimated in quantity. Non detected concentrations were qualified and flagged "UJ". The following samples and corresponding analytes were qualified and flagged:

- 06CA01-13, 06CA01-15
  - methane (J)

The surrogate compound, bromofluorobenzene, exhibited a %R above the QC limits of 75-135 percent for sample 06CA01-07. Detected concentrations for this sample that were not previously qualified, were qualified and flagged "J" as detected and estimated in quantity. The following samples and corresponding analytes were qualified and flagged:

- 06CA01-07
  - vinyl chloride (J)
  - 1,1-dichloroethene (J)
  - 1,1-dichloroethane (J)
  - 1,1,1-trichloroethane (J)
  - bromodichloromethane (J)
  - trichloroethene (J)
  - cis-1,2-dichloroethene (J)
  - trans-1,2-dichloroethene (J)

The trip blank 06CA01-21 associated with samples collected on October 4, 2005 contained measurable concentrations of chloromethane and toluene at 0.089ug/L and 0.19ug/L, respectively. Detected samples that did not exceed the 95% confidence interval (5 X the blank concentration) of 0.44 ug/L and 0.95 ug/L were qualified and flagged "UB" as non-detect due to blank contamination. The following samples and corresponding analytes were qualified and flagged:

- 06CA01-09, 06CA01-26
  - chloromethane (UB)

#### Total and Dissolved Metals

The following samples demonstrated higher concentrations of manganese in the dissolved sample than in the total sample. The detected concentrations of the affected analytes in both the total and dissolved samples were qualified and flagged "J" as detected and estimated in quantity. The following samples and corresponding analytes were qualified and flagged:

- 06CA01-01, 05CA40-17
  - total manganese (J)
- 06CA01-02, 05CA40-18
  - dissolved manganese (J)

Field duplicate 06CA01-15, exhibited a RPD for total iron of 78% when compared to native sample 06CA01-13, which exceeded the QC limit of 30% for aqueous samples. The detected concentrations of the affected analytes in both the native and duplicate samples were qualified and flagged "J" as detected and estimated in quantity. Non detected concentrations were qualified and flagged "UJ". The following samples and corresponding analytes were qualified and flagged:

- 05CA40-13, 05CA40-15
  - total iron (J)

#### General Chemistry

All QC data were within applicable limits, therefore no further corrective action was deemed necessary or taken.

## **Conclusion**

Overall, the analytical results are acceptable as reported unless otherwise qualified herein. Therefore the validated analytical results can be used to make project decisions.